

PRICED AND ILLUSTRATED CATALOGUE
AND
DESCRIPTIVE MANUAL
OF
MATHEMATICAL INSTRUMENTS AND MATERIALS,
FOR
DRAWING, SURVEYING AND CIVIL ENGINEERING.



963 623 712

MADE, IMPORTED AND SOLD, WHOLESALE AND RETAIL,
BY

JAMES W. QUEEN & CO.

924 Chestnut and 925 Sansom Street, Philadelphia,

GEORGE S. WOOLMAN, *Agent*,

No. 116 Fulton St., New York.

1877.

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Having the largest and best assorted Stock of Mathematical, Optical and Philosophical Instruments, both of foreign and domestic manufacture, in the United States, we are enabled to offer unequalled facilities and inducements to intending purchasers.

In ordering Instruments and materials from this Catalogue, it is merely necessary to state the edition and the numbers of the articles. *All former Editions are superseded by this.*

All instruments and materials sold by us are warranted perfect for the purposes intended; and if not found so upon receipt, should be returned and exchanged for others.

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The prices throughout the Catalogue will be strictly adhered to.

When no satisfactory Philadelphia or New York reference is given by the party ordering the goods, the money should accompany the order; but where it does not, (either from want of confidence or other cause,) the goods will be forwarded by express, with bill, C. O. D., (collect on delivery,) *provided a remittance equal to one-third the total amount of the order is sent with it.*

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JAMES W. QUEEN & CO.

PHILADELPHIA, October 1, 1876.

N. B. — Liberal discounts to dealers.

PRICED AND ILLUSTRATED CATALOGUE

OF

MATHEMATICAL INSTRUMENTS

AND

MATERIALS FOR DRAWING, SURVEYING AND
CIVIL ENGINEERING,



MADE, IMPORTED AND SOLD, WHOLESALE AND RETAIL.

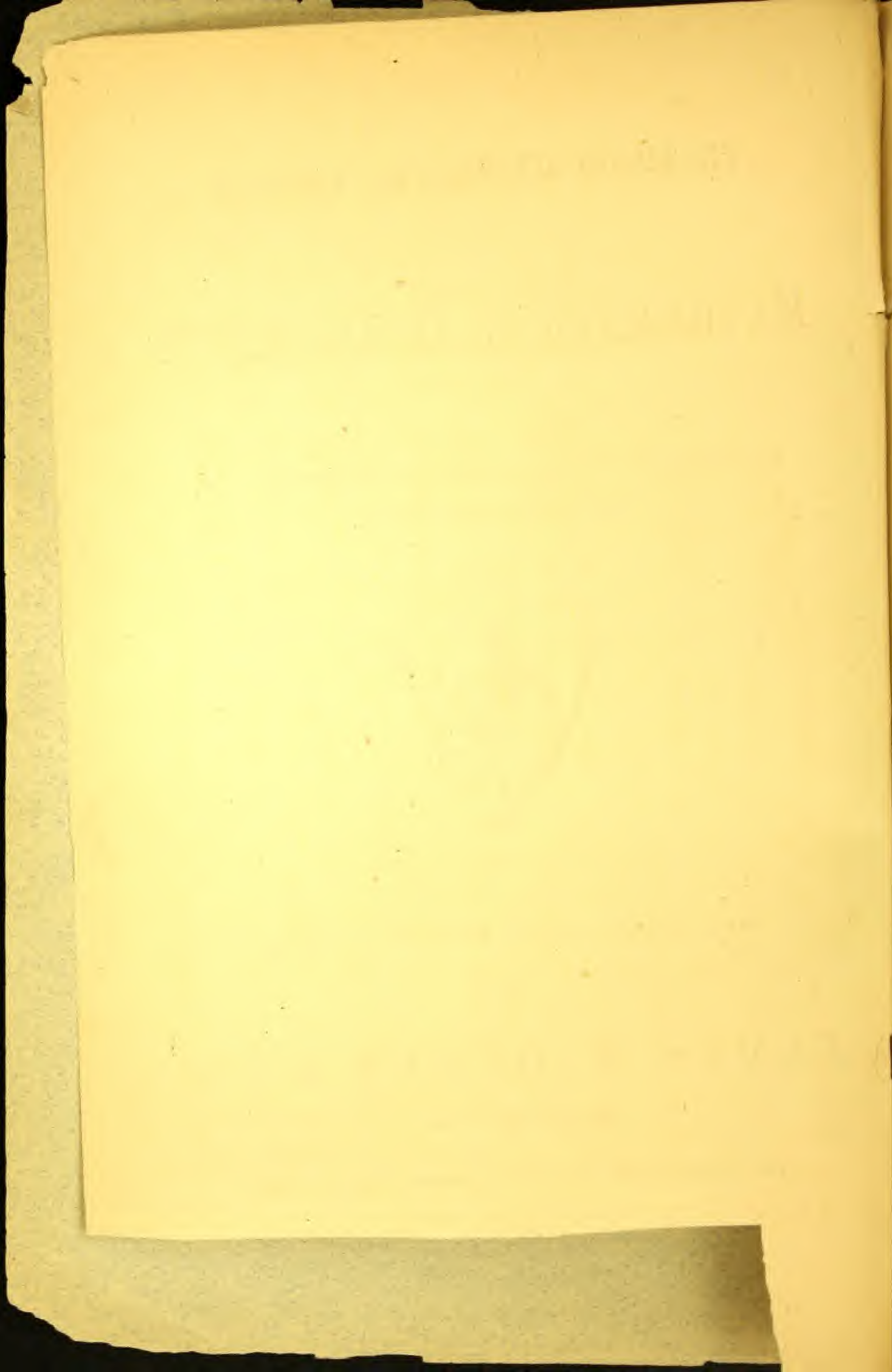
BY

JAMES W. QUEEN & CO.

Thirty-Ninth Edition.

924 CHESTNUT AND 925 SANSON STREET, PHILADELPHIA.

Lengthening Bar, . . . 1877. 3 10

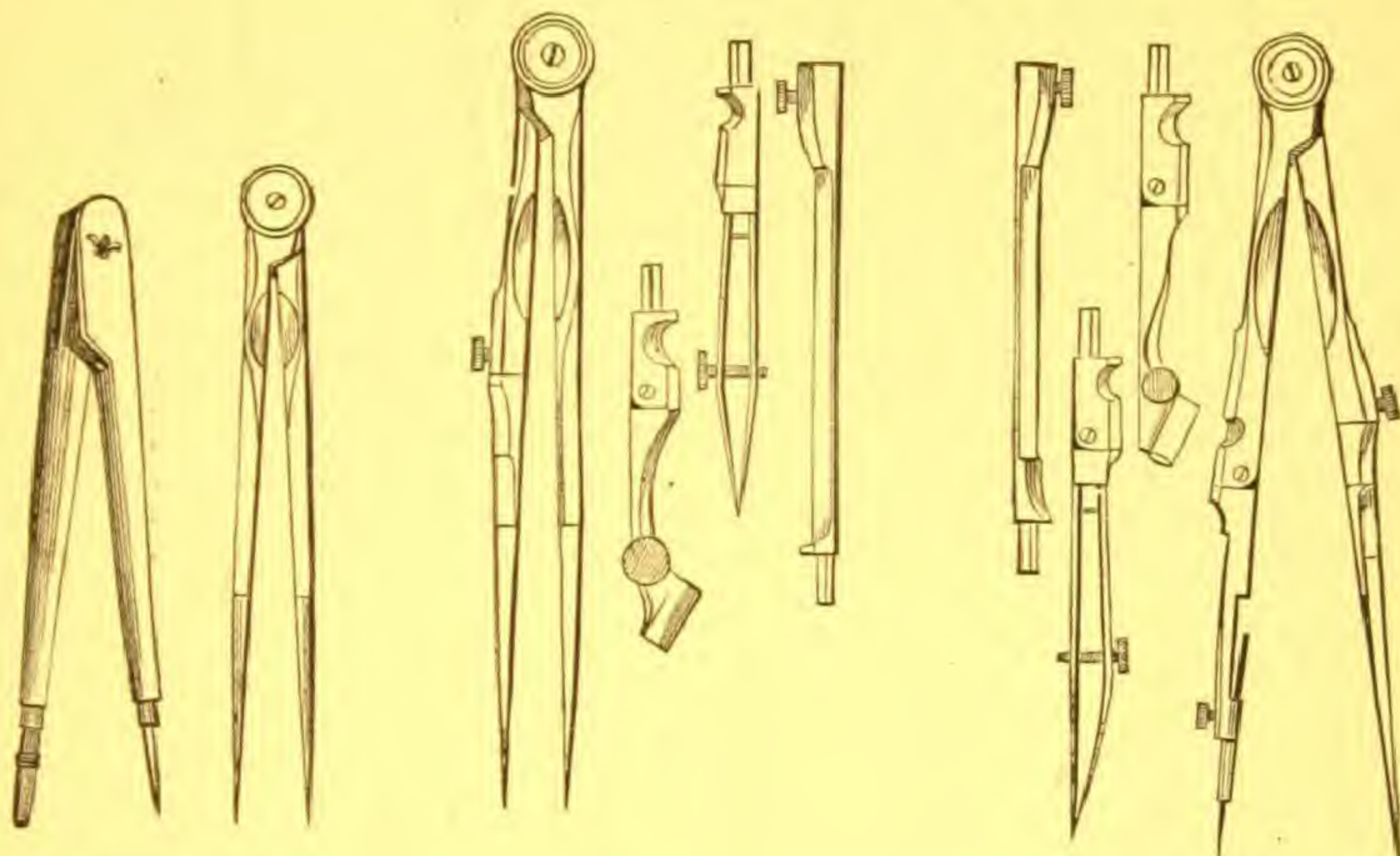


CATALOGUE OF MATHEMATICAL INSTRUMENTS.

CHAPTER I.

MATHEMATICAL INSTRUMENTS OF BRASS.

FOR SCHOOLS.



No.	00.	5.	14.	16.	PRICE.
00.	Wood Dividers, 13 in. long, with crayon holder, for black-board drawing,				\$1 00
0.	Do.	16	do.	do.	1 25
1.	Do.	20	do.	do.	1 50
2.	Do.	24	do.	do.	1 75
3.	Do.	27	do.	do.	2 00
4.	Do.	30	do.	do.	2 25
4 1/2.	Do.	36	do.	do.	2 50
5.	Brass Dividers, 3 1/2 inches long, screw joint,				25
6.	Do.	4 1/2	do.	do.	30
7.	Do.	5 1/2	do.	do.	38
8.	Do.	6 1/2	do.	do.	45
9.	Do.	4 1/2	do.	rivet joint,	20
10.	Do.	5 1/2	do.	do.	30
11.	Do.	6 1/2	do.	do.	35
12.	Do.	4 1/2	do.	screw joint and pencil leg,	40
13.	Do.	5 1/2	do.	do.	50
13 1/2.	Do.	6 1/2	do.	do.	60
14.	Brass Dividers, 4 1/2 inches long, with Pen and Pencil Points and Lengthening Bar,				60
15.	Brass Dividers, 6 inches long, with Pen and Pencil Points and Lengthening Bar,				75
16.	Brass Dividers, Needle Point, 4 1/2 inches long, with Pen and Pencil Points and Lengthening Bar,				75



18.



19.



20.



21.

No.		Price.
17.	Brass Dividers, Needle Point, 6 inches long, with Pen and Pencil Points and Lengthening Bar,	\$1 00
18.	Brass Dividers, 3 inches long, with Pen and Pencil Points,	60
19.	Brass Bow Pen, no spring,	60
20.	Brass Bow Pen, with adjusting screw and spring,	70
21.	Brass Bow Pencil, no spring,	60



22.



23.



25.



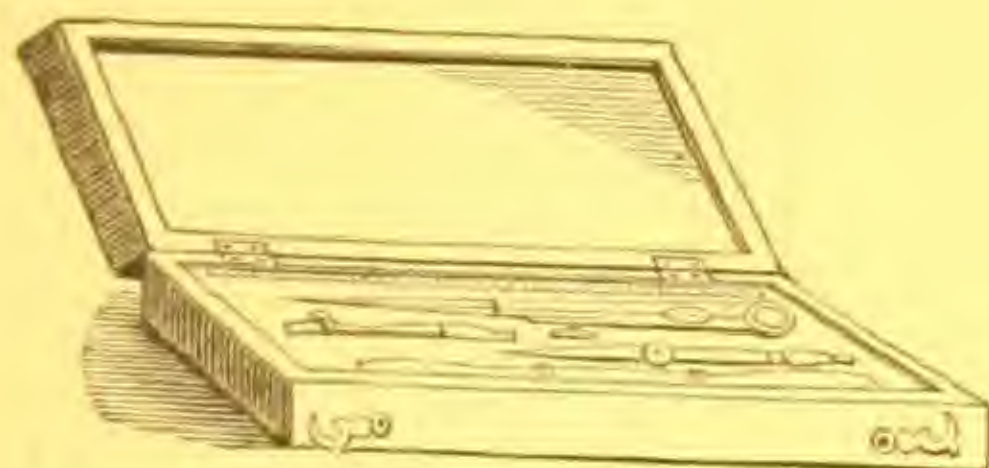
26.



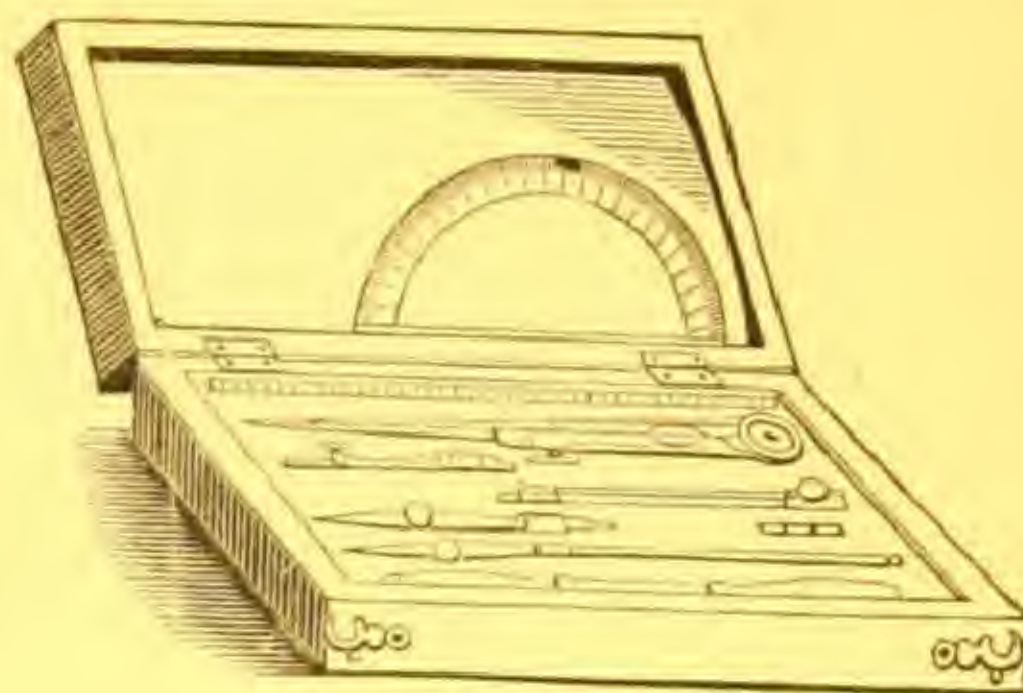
29.

22.	Brass Bisecting Dividers,	60
23.	Brass Proportional Dividers, divided for lines, in case,	2 25
24.	Drawing Pen, black handle,	20
25.	Drawing Pen, ivory handle,	30
26.	Roulette for Dotting Lines,	65
26½.	Do. do. with three wheels,	85
27.	Furniture for Beam Compass, of Brass, with adjusting screw, in morocco case,	5 50
28.	Double Drawing or Railroad Pen, for parallel lines, brass mounted,	2 25
29.	Fox's Patent Lead Holder, for pencil leg of Dividers,	25

CASES OF BRASS DRAWING INSTRUMENTS. FOR SCHOOLS.



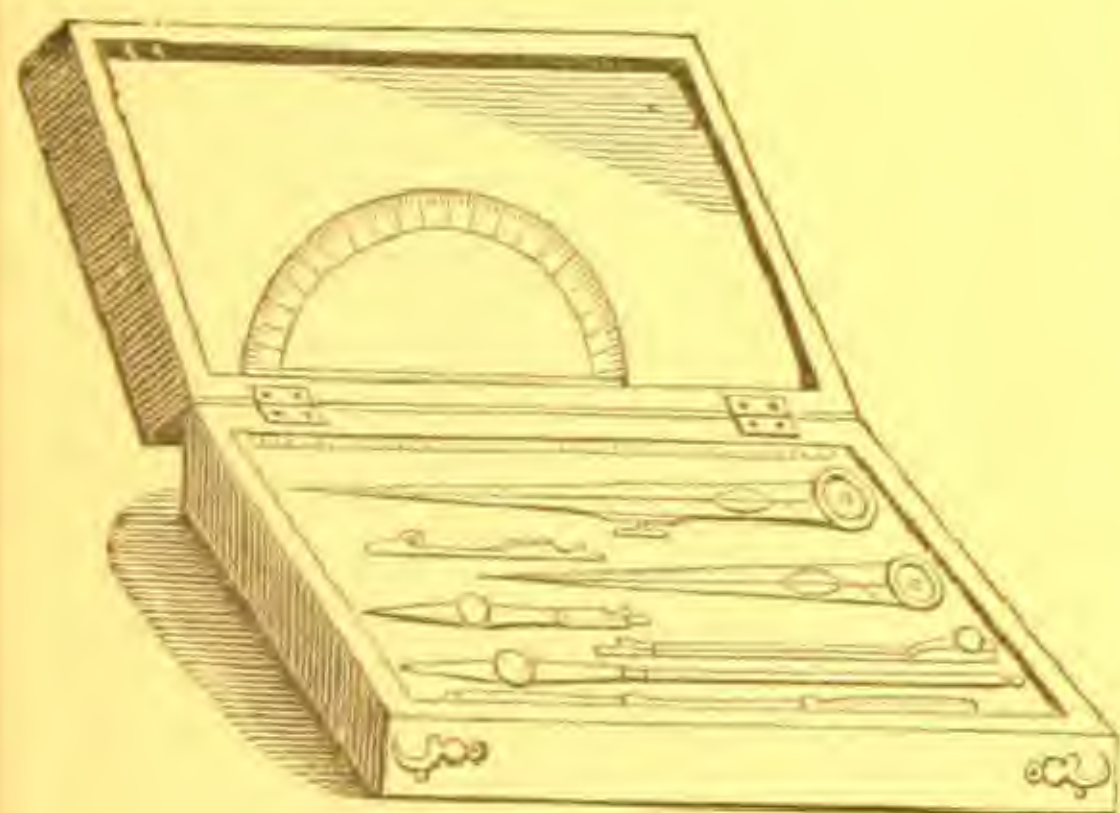
48



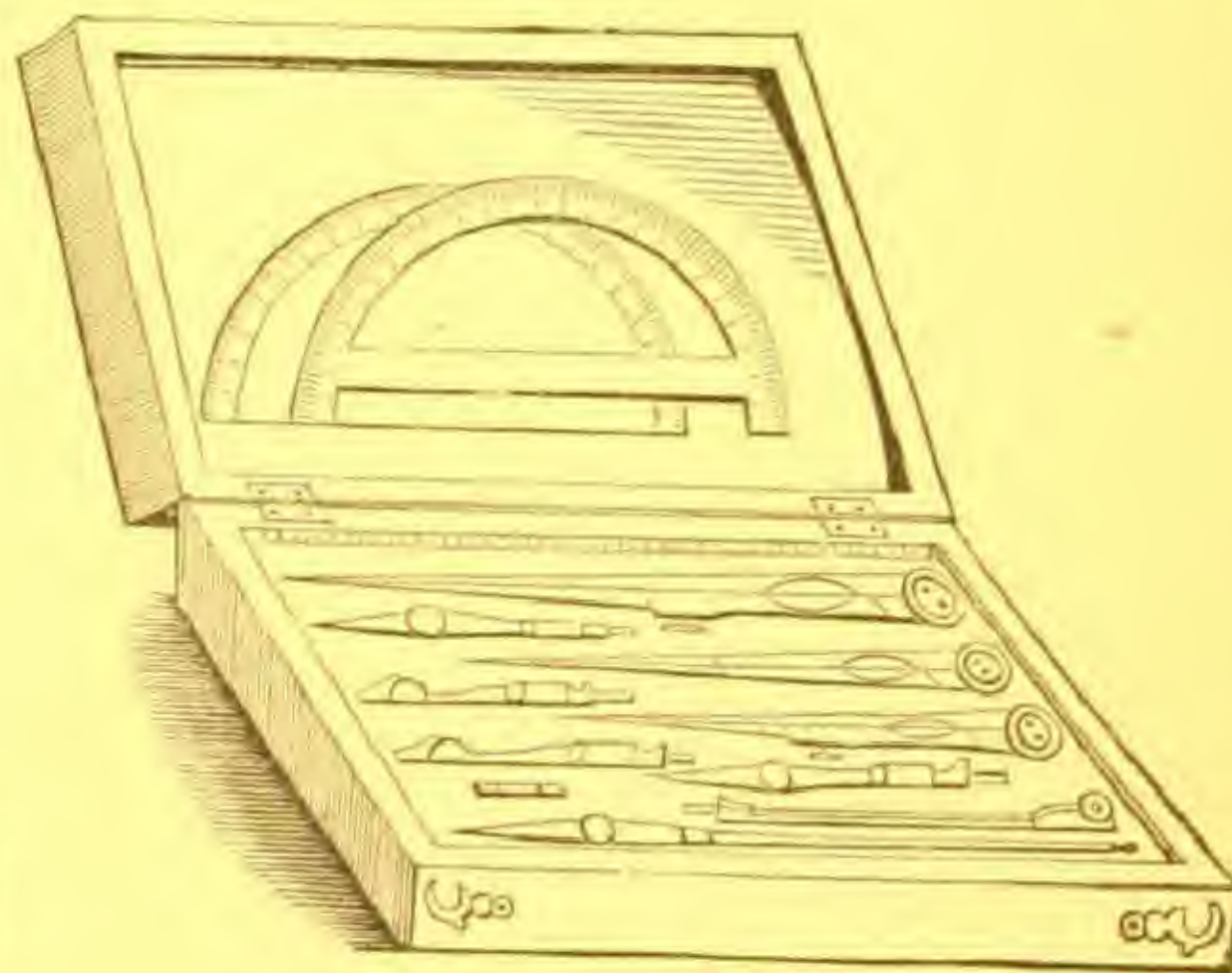
49

All sets of instruments from No. 48 to 64½ are fitted with Fox's Patent Lead Holder, No. 29, when sold at retail.

No.		PRICE.
48.	Wood Box; containing pair 4½ inch Dividers, with Pen and Pencil Points, and Crayon Holder,	\$0 60
49.	Wood Box; containing pair 4½ inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 14. Ebony handle Drawing Pen, No. 24. Crayon Holder, Horn Protractor and Divided Rule,	90



50 and 51.



55.

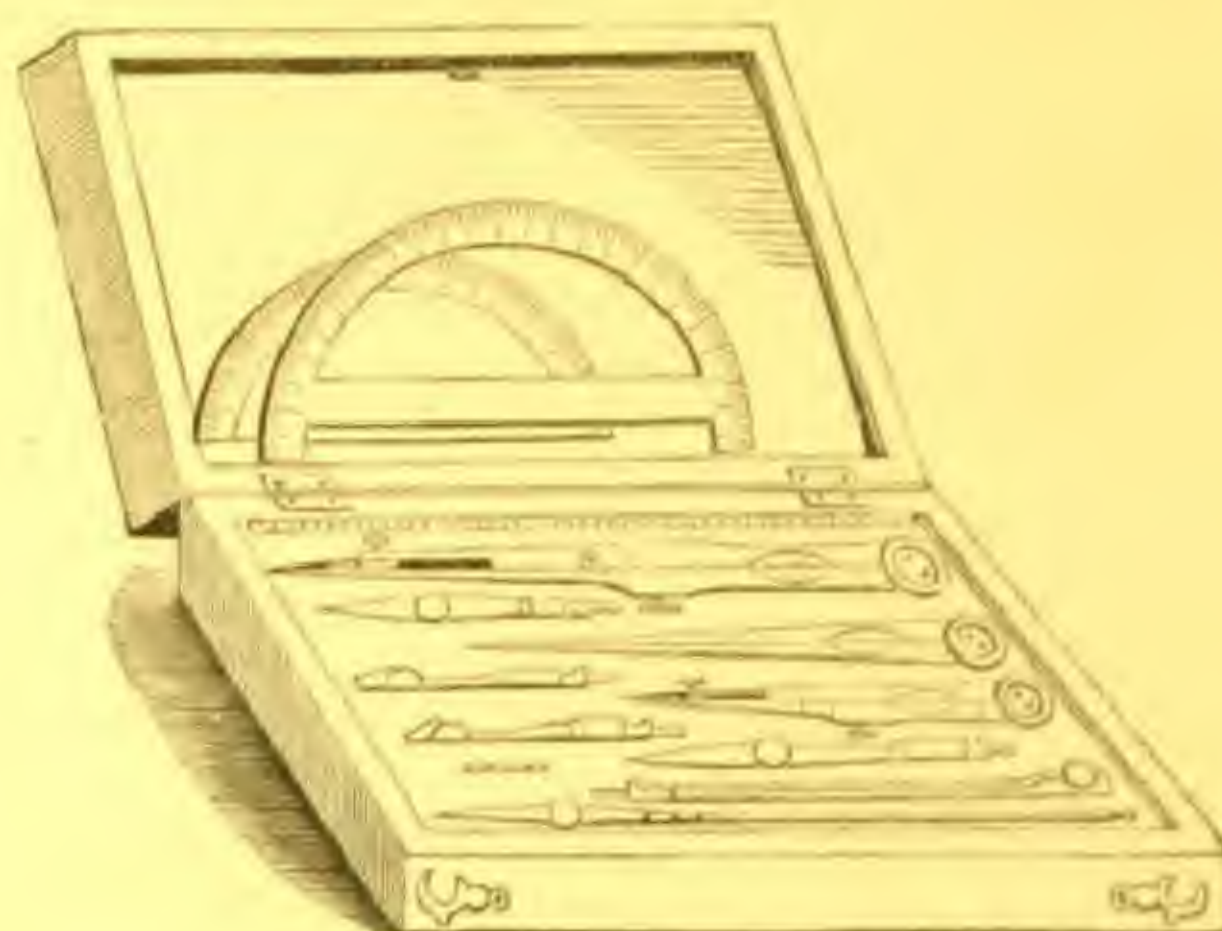
50.	Wood Box; containing pair of 4½ inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 14. Pair of 3½ inch plain Dividers, No. 5. Drawing Pen, No. 24. Horn Protractor, No. 301. Crayon Holder and Divided Rule,	1 15
51.	Rosewood Box; containing pair of 5½ inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 15. Pair of 4½ inch plain Dividers, No. 6. Drawing Pen, No. 24. Crayon Holder, Horn Protractor and Divided Rule,	1 60
52.	Same as No. 51, with Parallel Ruler,	2 00

6
No.

JAMES W. QUEEN & CO., PHILADELPHIA.

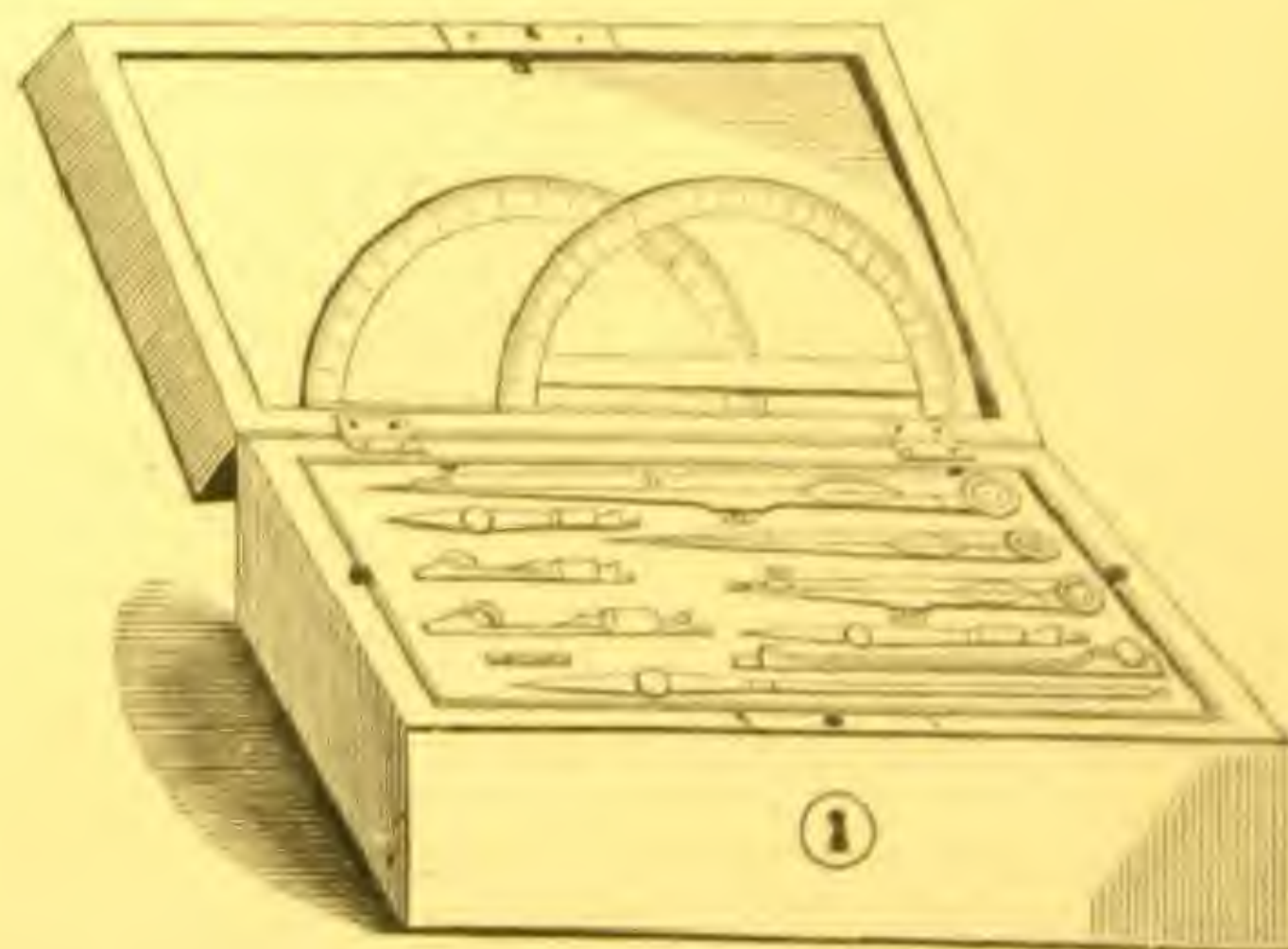
PRICE.

55. Rosewood Box; containing pair of 6 inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 15.
 Pair of $4\frac{1}{2}$ inch plain Dividers, No. 6.
 Pair of $3\frac{1}{2}$ inch Dividers, with Pen and Pencil Points.
 Drawing Pen, No. 24.
 Brass Protractor, No. 306.
 Horn Protractor, No. 301.
 Divided Wood Rule, \$2 65
56. Same as No. 55, but with the instruments set in a tray, so that colors, &c., may be put below, 3 25



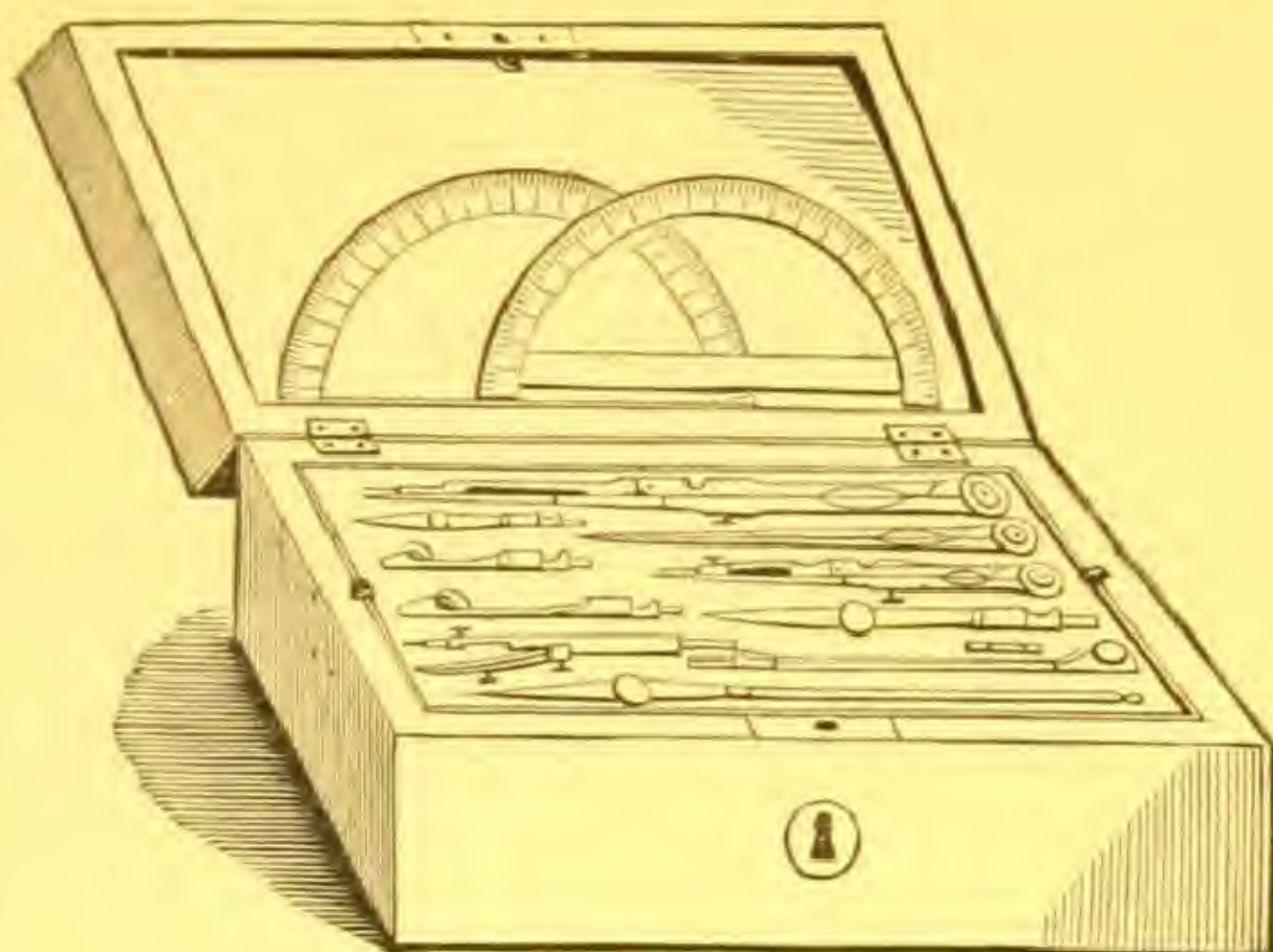
57.

57. Rosewood Box; containing pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar, No. 17.
 Pair of $4\frac{1}{2}$ inch plain Dividers, No. 6.
 Pair of $3\frac{1}{2}$ inch Needle Point Dividers, with Pen and Pencil Points.
 Drawing Pen, No. 24.
 Brass Protractor, No. 306.
 Horn Protractor, No. 301.
 Divided Wood Rule, 3 25



58.

58. Same as No. 57, but with lock and key, and the instruments set in a tray, so that colors may be put below, 3 75



62.

No.

PRICE.

62. Rosewood Box, with lock and key, the instruments set in a tray, so that colors, &c., may be put below; containing:

Pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar, No. 17.

Pair of 4½ inch plain Dividers, No. 6.

Pair of 3½ inch Needle Point Dividers, with Pen and Pencil Points.

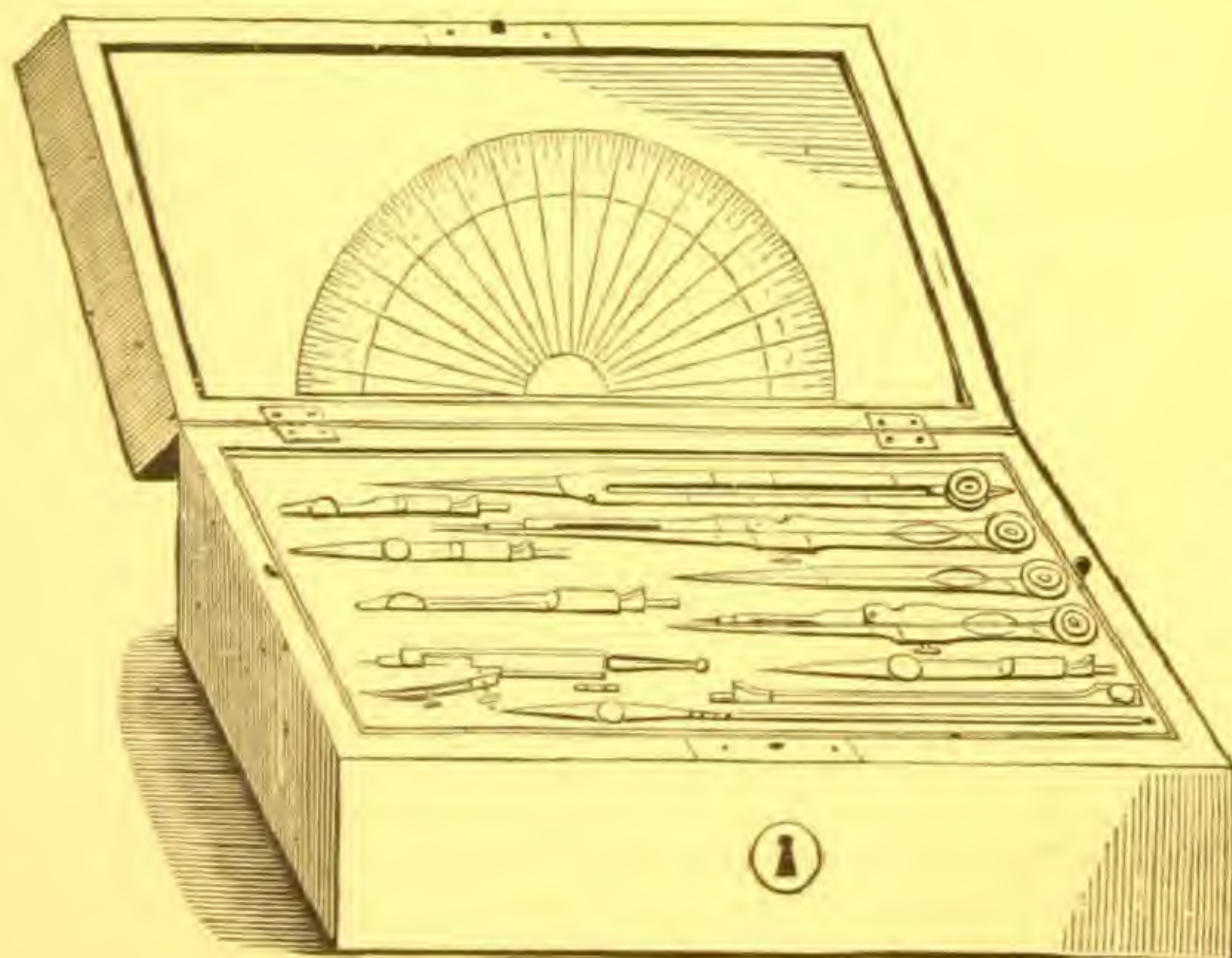
Spring Bow Pen, with Needle Point, No. 20.

Drawing Pen, No. 24.

Brass Protractor, No. 306.

Horn Protractor, No. 301.

Divided Wood Rule, 4 50



64.

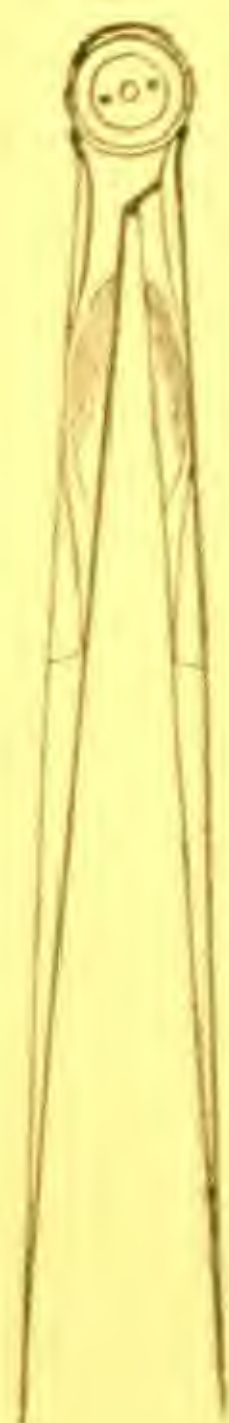
64. Same as No. 62, with the addition of a pair of Proportional Dividers; has no brass Protractor, but has wood Triangle and Irregular Curves,

7 50

CHAPTER II.

MATHEMATICAL INSTRUMENTS OF GERMAN SILVER,

FOR ACCURATE DRAFTING.



65.



69.

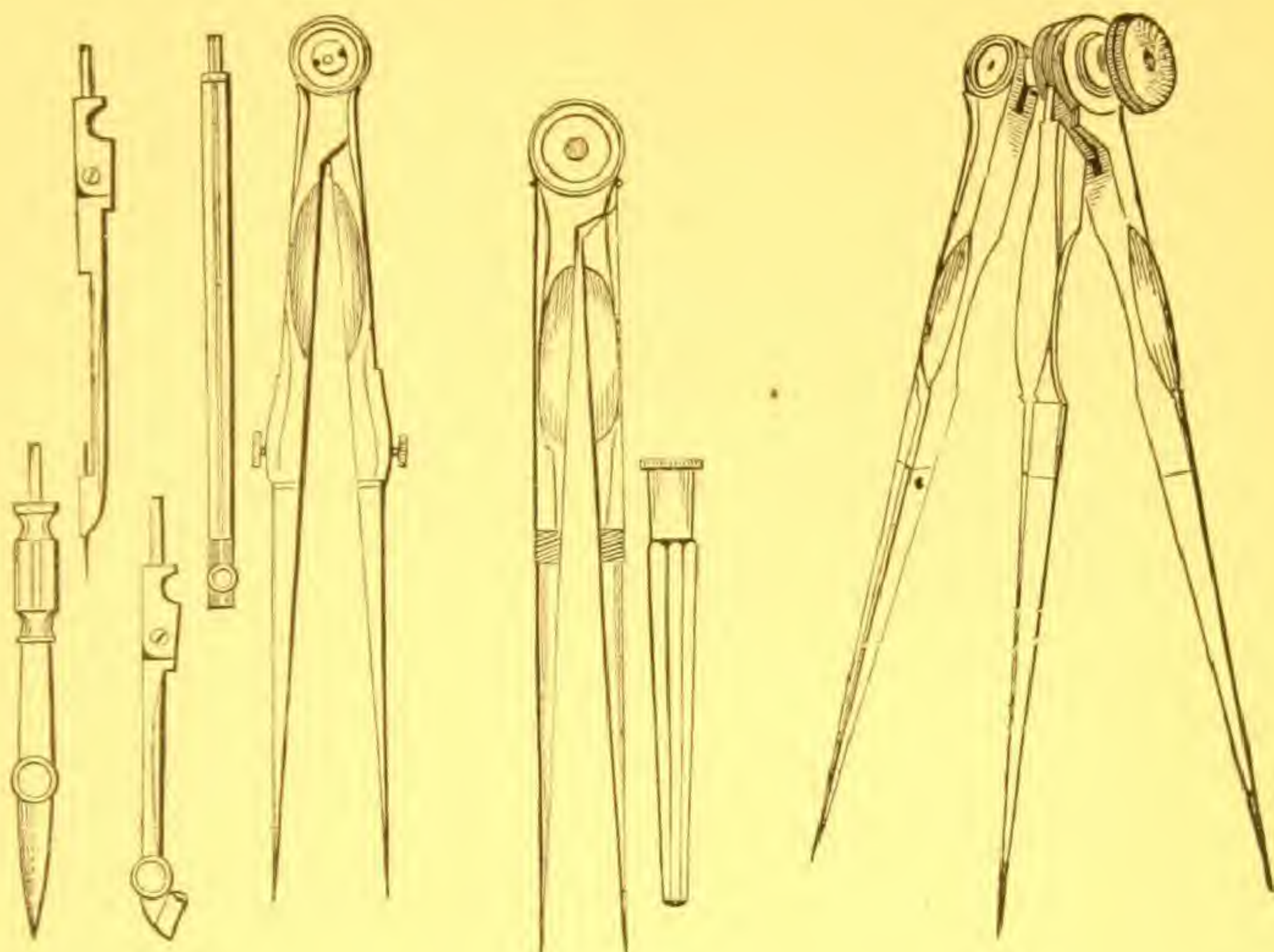


71½

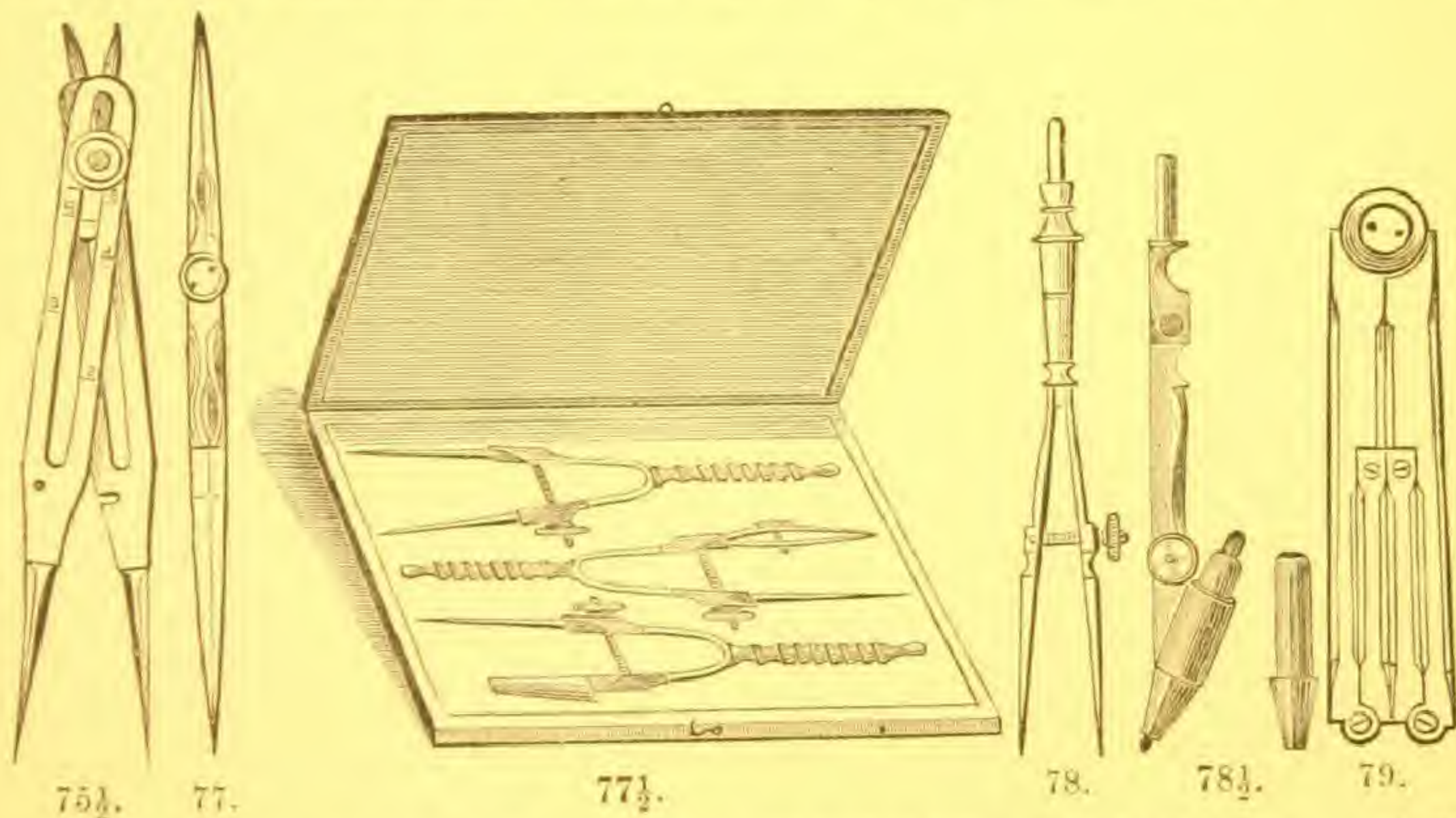


72.

No.							PRICE
65.	Dividers,	German Silver,	4 inches long,	steel joints,	.	.	\$0 70
66.	Do.	do.	5	do.	do.	.	80
67.	Do.	do.	6	do.	do.	.	1 00
68.	Do.	do.	7	do.	do.	.	1 25
69.	Do.	do.	4	do.	do.	with hair spring	1 25
70.	Do.	do.	5	do.	do.	do.	1 80
71.	Do.	do.	6	do.	do.	do.	2 50
71½.	German Silver Plain Dividers, 3 inches long, with handle,						75
72.	Dividers, German Silver, 3 inches long, with Pen, Pencil, and Needle Points,						2 50



No.		PRICE.
73.	Dividers, German Silver, 6 inches long, steel joints, with Pen, Pencil, and Needle Points and Lengthening Bar,	\$3 25
74.	Dividers, German Silver, 5 inches long, steel joints, with shield for pocket,	1 50
75.	Dividers, German Silver, 5 inches long, steel joints, with three legs,	3 50



75 1/2.	Proportional Dividers, German Silver, 6 1/2 inches long, divided for lines,	2 75
77.	Bisecting Dividers, German Silver,	1 12
77 1/2.	Set of three Steel Bows, Pen, Pencil and Dividers, in box,	per set, 4 75
77 3/4.	Same as 77 1/2, but finer finish and Needle Points,	do. 6 75
78.	Spacing Dividers, all steel, with Spring and Adjusting Screw,	1 25
78 1/2.	Fox's Patent Lead Holder, for pencil leg of Dividers,	25
79.	Pocket Dividers, German Silver, with Folding Pen and Pencil Points,	5 50



80.



81.



82.



83.

No.		PRICE
80.	Furniture for Beam Compasses, German Silver, with adjusting screw, in morocco case,	\$6 50
81.	Bow Pen, all steel, with Spring and Adjusting Screw,	1 50
82.	Bow Pen, German Silver, with Spring and Adjusting Screw,	1 62
83.	Bow Pen, German Silver, with Spring and Adjusting Screw, and with Pencil Point,	2 50



84.



85.



86.




89.



92.

84.	Bow Pencil, all steel, with Spring and Adjusting Screw,	
85.	Drawing Pen for curves,	1 50
86.	Do. for heavy border lines,	1 50
87.	Do. 4 to 6 inches long, medium finish, hinge to Pen,	2 00
88.	Do. 4 to 6 inches long, fine finish, hinge to Pen,	40
89.	Do. 4 to 6 inches long, German Silver; fine finish, hinge to Pen,	50
	and Protracting Pin,	75

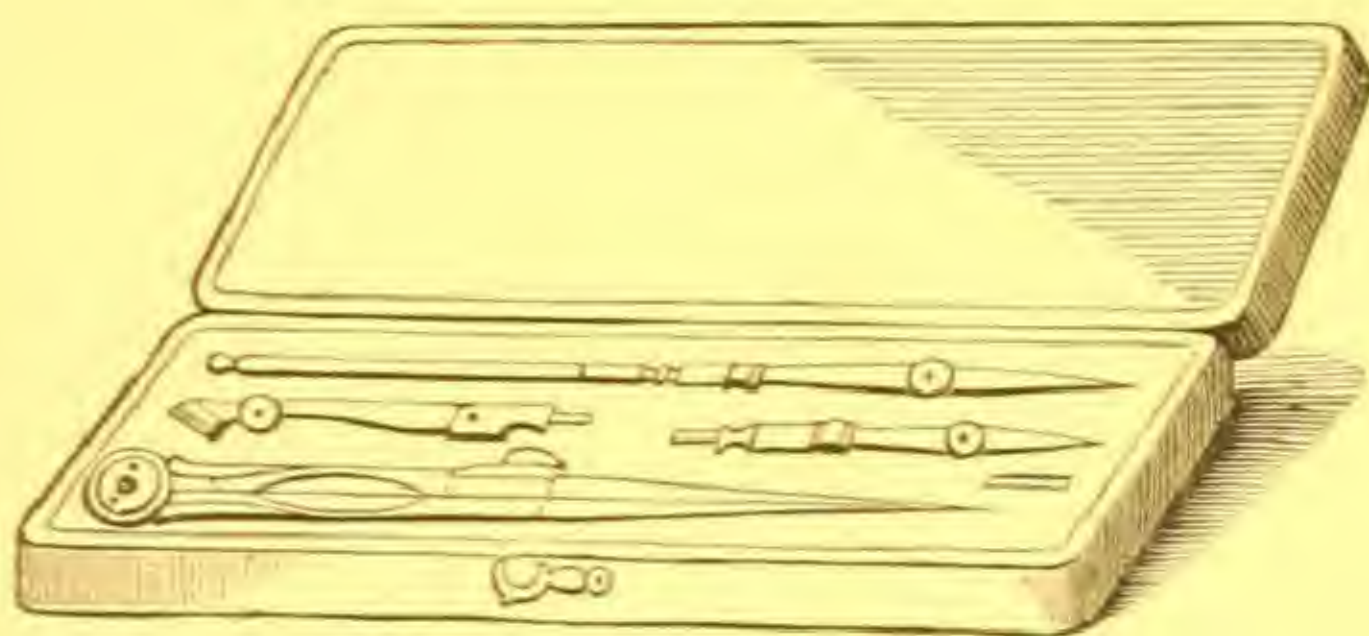
No.		PRICE.
91.	Drawing Pen, German Silver; fine finish, hinge to Pen, German Silver Points, for red ink,	\$0 75
92.	Double Drawing Pen (see No. 28, page 4),	2 25
93.	Double Drawing Pen or Road Pen, for parallel lines, German Silver,	2 75
94.	Roulette for Dotting Lines,	75
95.	Map Perambulator, for measuring the length of curved lines, rivers, railroads, &c., on maps, each,	1 50

 For Boxwood and Ivory Scales, Protractors, &c., &c., see pages 38 to 41.

Parties wanting cases made up of these Instruments, can select the pieces, by the above list, that are best adapted to their purpose, and we will have boxes made to suit, at an additional cost of from \$5 to \$12, according to the sizes of the boxes, which are made of rosewood, mahogany or walnut, highly finished.

CASES OF FINE GERMAN SILVER INSTRUMENTS.

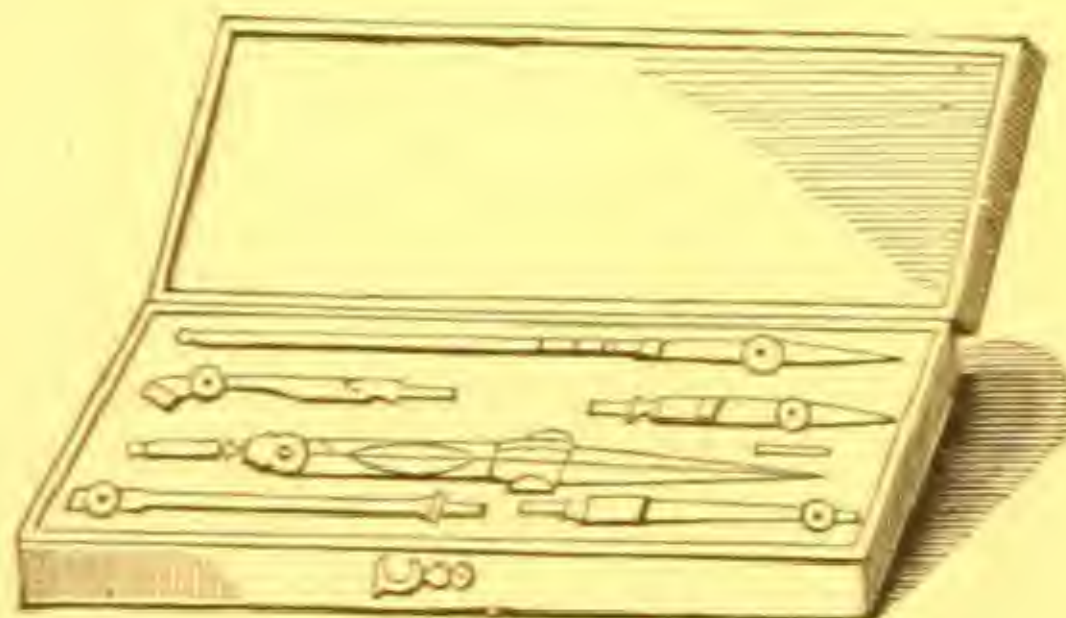
FOR ENGINEERS, ARCHITECTS, AND MACHINISTS.



100.

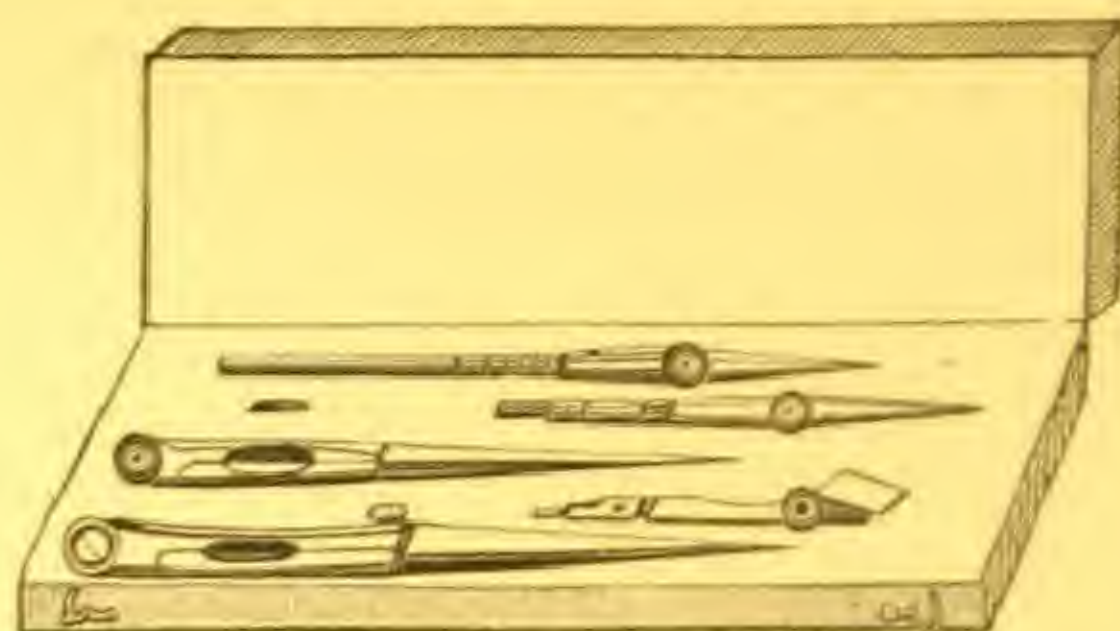
All sets of instruments from No. 100 to 134 1/2 fitted with Fox's Patent Lead Holder, No. 78 1/2, when sold at retail.

100. Morocco Box; containing pair of 5 1/2 inch Dividers, with Pen and Pencil Points,
Drawing Pen, No. 88, 3 00



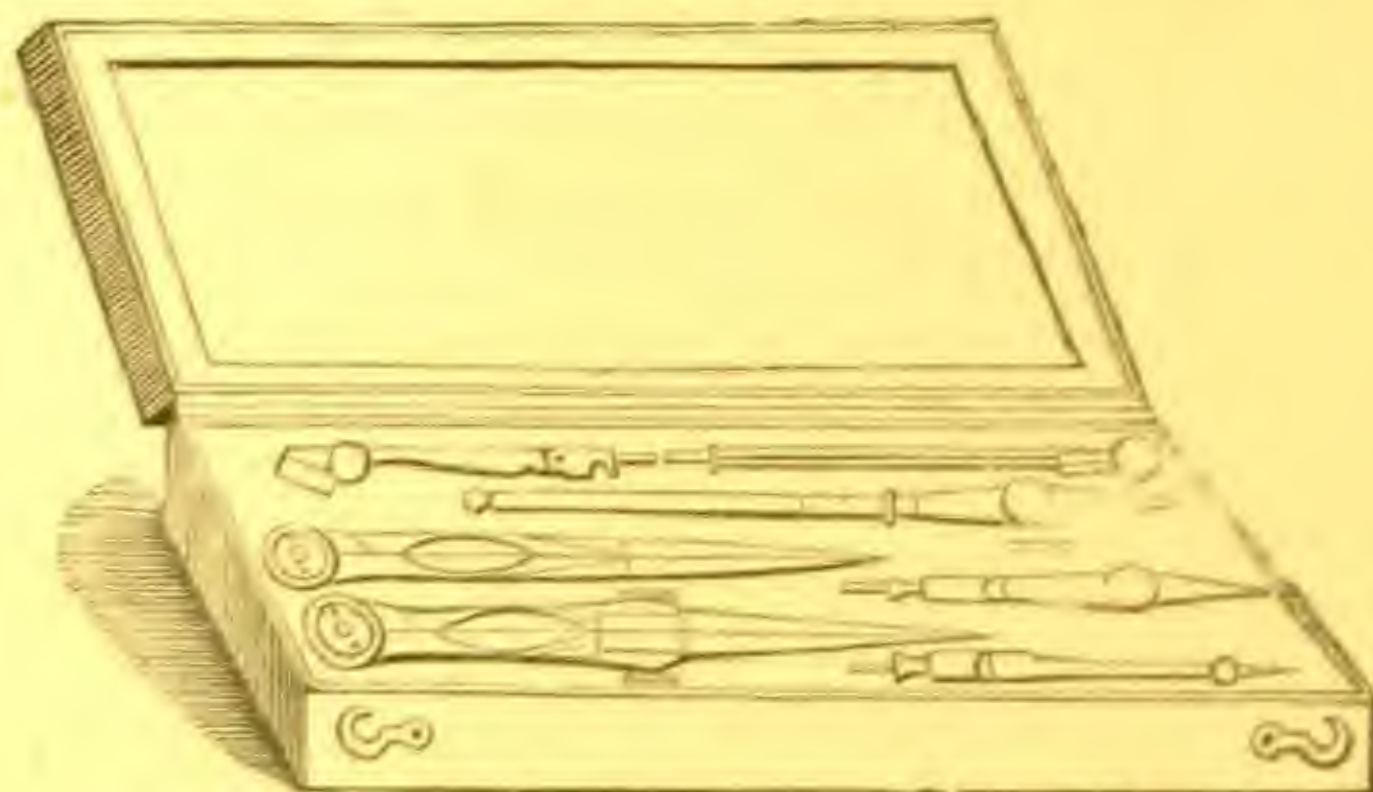
101

101. Morocco Box; containing pair of 3 inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 72.
Drawing Pen, No. 89, 4 50



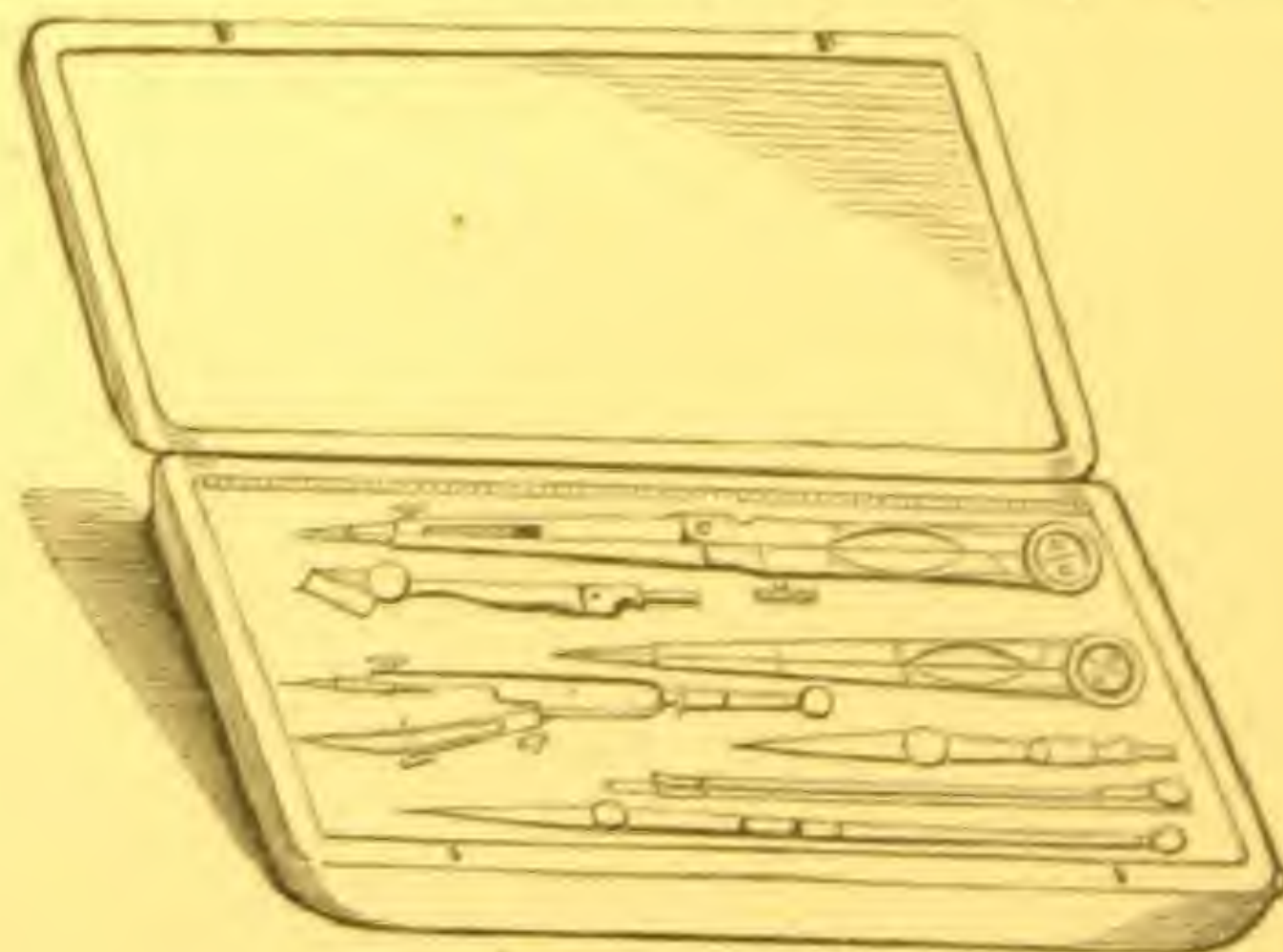
102.

- | No. | Price |
|--|--------|
| 102. Morocco Box; containing pair of 5½ inch Dividers, with Pen and Pencil Points. | |
| Pair of 5 inch plain Dividers, No. 66. | |
| Drawing Pen, No. 88, | \$3 50 |



103.

- | | |
|--|------|
| 103. Morocco Box; containing pair Dividers 6 inches long, with Pen, Pencil and Needle Point and Lengthening Bar, No. 73. | |
| Pair plain Dividers, 5 inches long, No. 66. | |
| Drawing Pen, No. 89, | 5 00 |
| 103½. Same as No. 103, but with Polished Walnut Box, with lock and key and tray, | 7 50 |



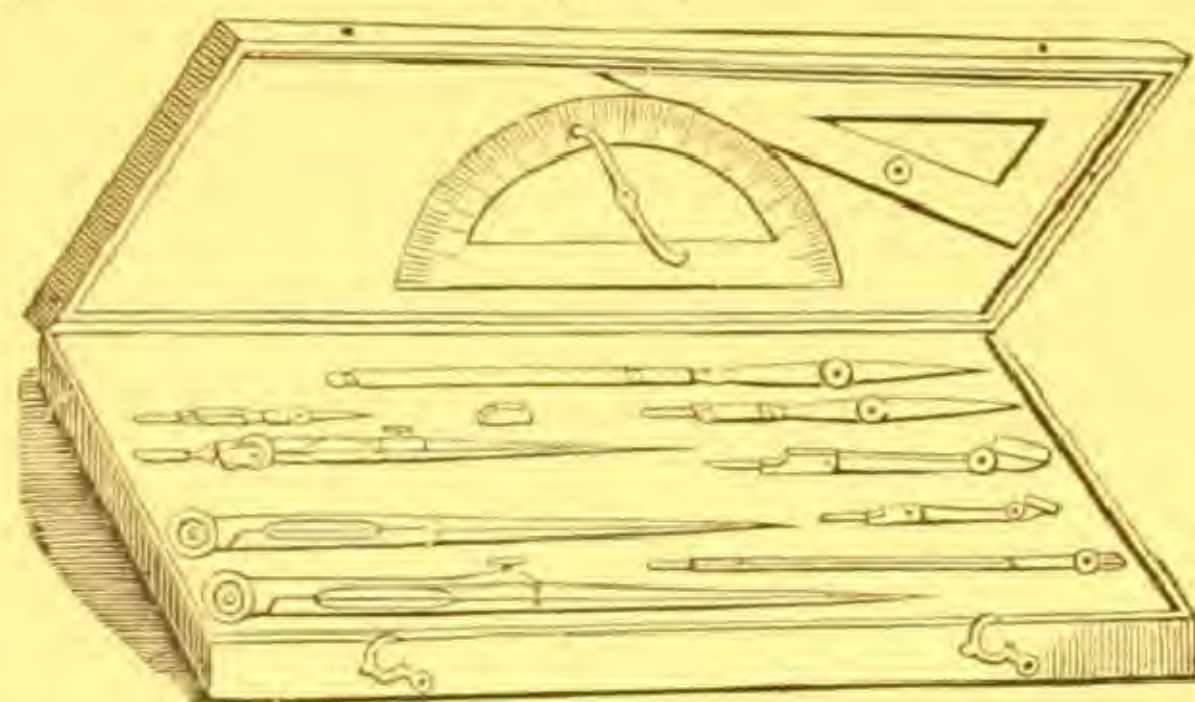
104

No.

PRICE.

104. Morocco Box, rounded corners, for carrying in the pocket; containing pair of $4\frac{3}{4}$ inch Dividers, with Hinge in one Leg, Needle Points, with Pen and Pencil Points and Lengthening Bar.
 Pair 4 inch plain Dividers, rounded points.
 Spring Bow Pen, Needle Point.
 Drawing Pen, Ivory Handle.
 5 inch Ivory Rule, divided to eighths,

\$7 50



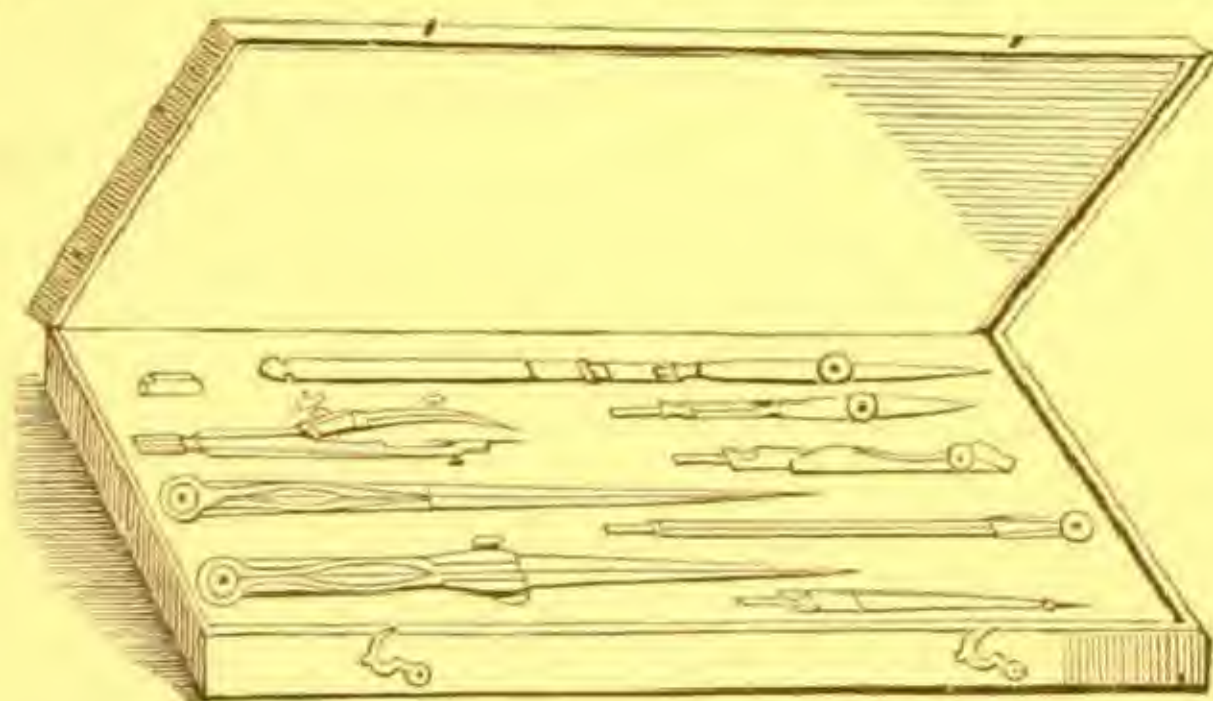
105.

105. Morocco Box; containing pair $5\frac{1}{2}$ inch Dividers, with Pen and Pencil Points and Lengthening Bar.
 Pair of 5 inch plain Dividers, No. 66.
 Pair 3 inch Dividers, with Pen and Pencil Points.
 Drawing Pen, No. 89.
 German Silver Protractor, No. 310.
 German Silver Square,

8 50

- 105½. Same as No. 105, but with Polished Walnut Box, with lock and key and tray,

10 50



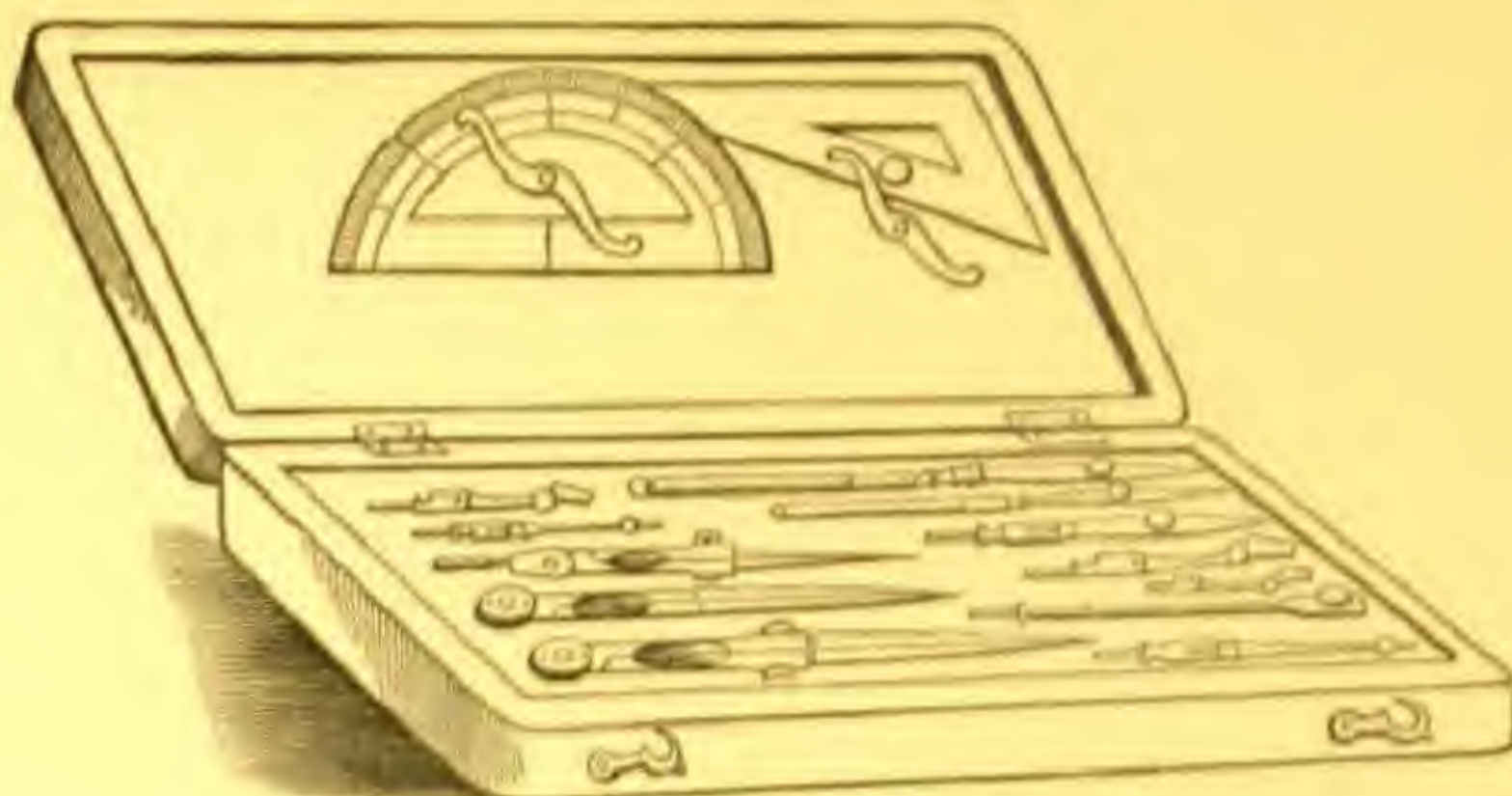
106.

106. Morocco Box; containing pair of $5\frac{1}{2}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 73.
 Pair 5 inch plain Dividers, No. 66.
 Spring Bow Pen, No. 82.
 Drawing Pen, No. 89,
 106½. Same as No. 106, in Polished Walnut Box, with lock and key and tray,
 106¾. Morocco Box; containing pair 6 inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 73.
 Pair 5 inch plain Dividers, No. 66.
 Pair Spacing Dividers, No. 78.
 Bow Pen, No. 81.
 Bow Pencil, No. 84.
 Drawing Pen, No. 88,

6 50

9 00

10 00



107.

No.	PRICE
107. Morocco Box ; containing pair of $5\frac{1}{2}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 73. Pair of 5 inch plain Dividers, No. 66. Pair of 3 inch Dividers, with Pen, Pencil and Needle Point, No. 72. 2 Drawing Pens, No. 89. German Silver Protractor, No. 310. German Silver Square,	\$9 75
108. Same instruments as No. 107, in Polished Walnut Box, with lock and key and tray,	11 75



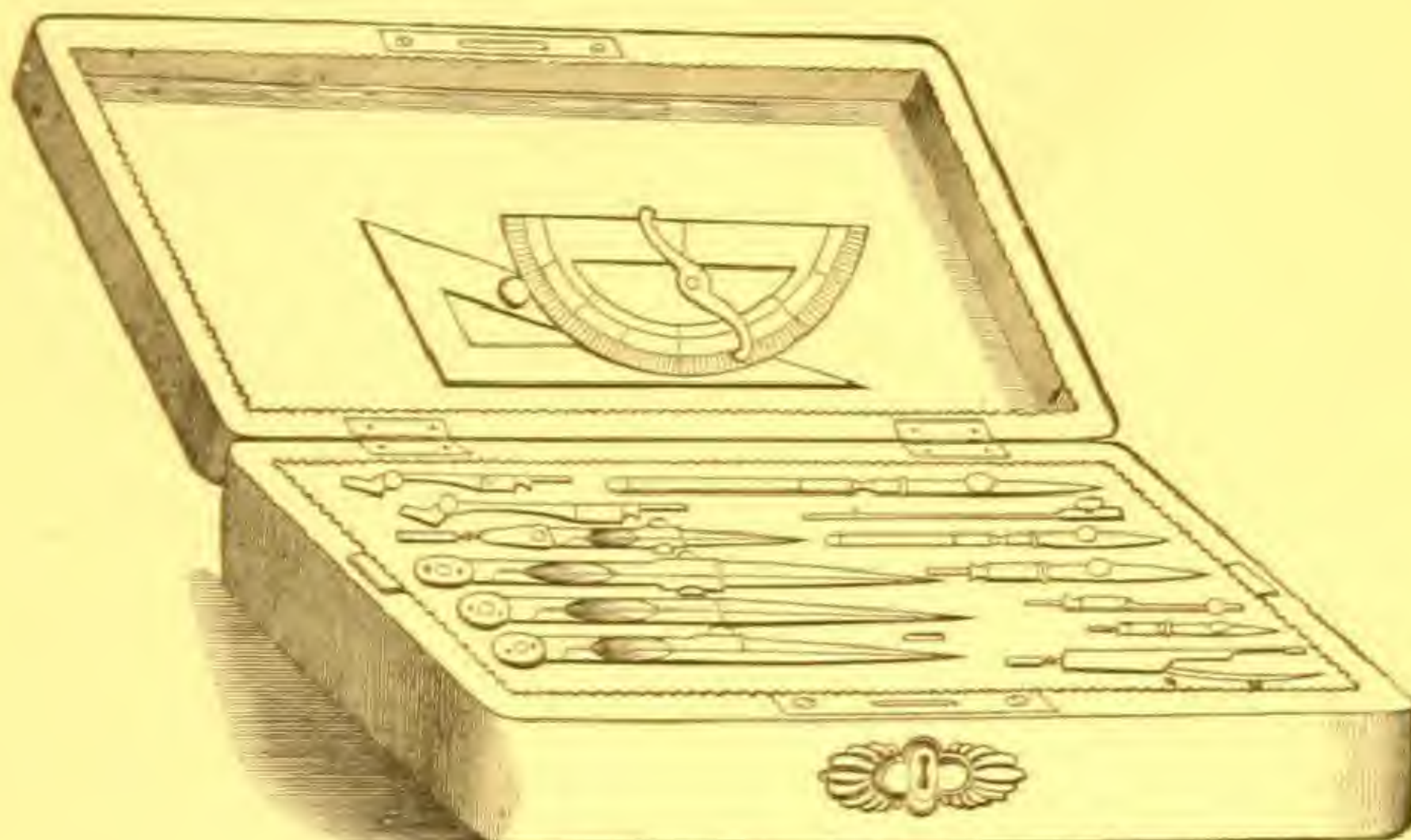
109.

109. Polished Walnut Box ; containing pair $5\frac{1}{2}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 73. Pair 5 inch plain Dividers, No. 66. Pair of 3 inch Dividers, with Pen, Pencil and Needle Points No. 72 Spring Bow Pen, with Needle Point, No. 82. 2 Drawing Pens, No. 89. German Silver Square, German Silver Protractor, No. 310,	12 50
109 $\frac{1}{2}$. Same as No. 109, in Polished Walnut Box, with lock and key and tray,	13 50

No.

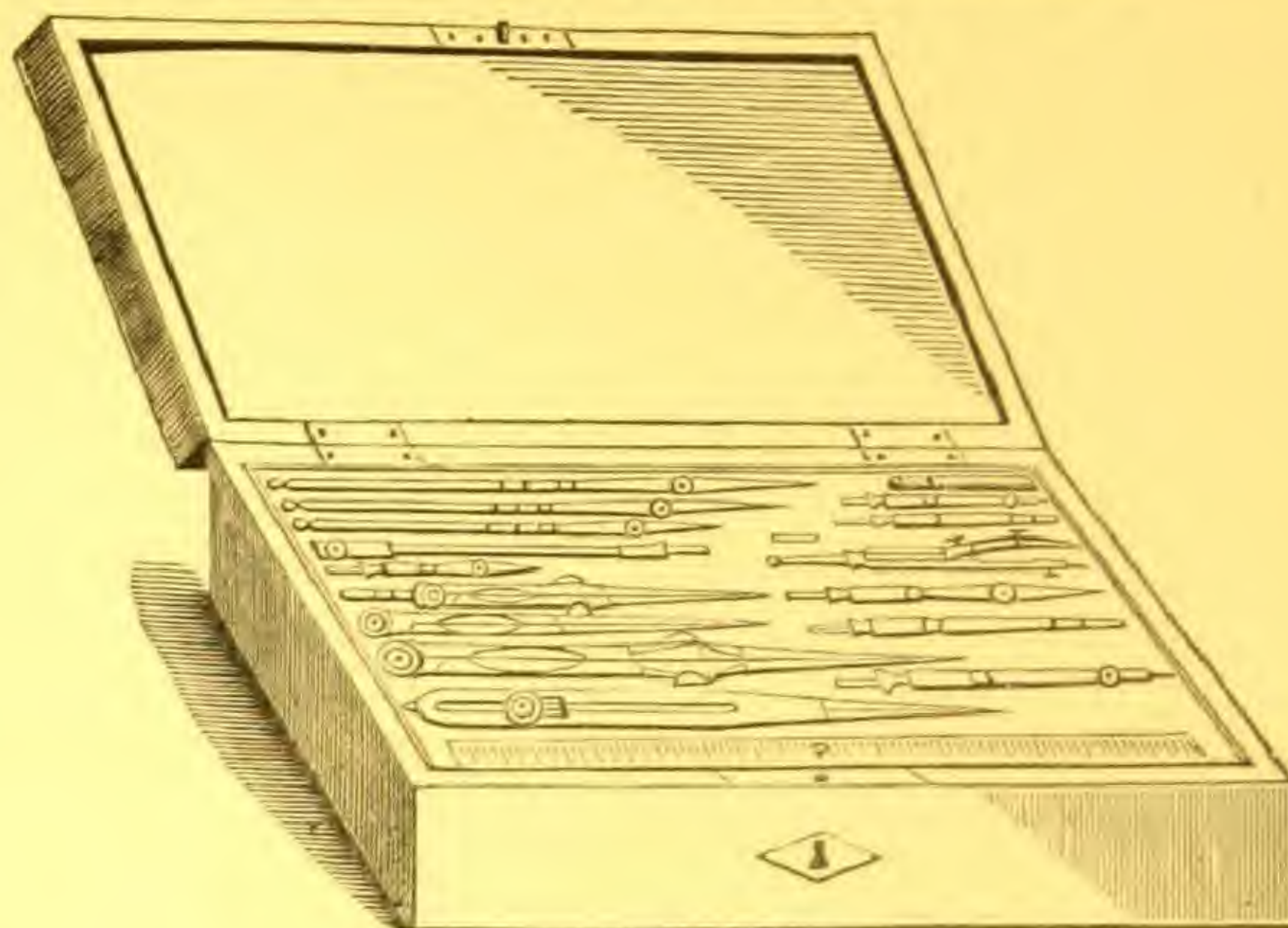
PRICE.

110. Polished Walnut Box; containing pair $5\frac{1}{2}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar, No. 73.
 Pair of 5 inch plain Dividers, No. 66.
 Pair of 5 inch Hair Spring Dividers, No. 70.
 Pair of 3 inch Dividers, with Pen, Pencil and Needle Points, No. 72.
 Spring Bow Pen, with Needle Point, No. 82.
 2 Drawing Pens, No. 89.
 German Silver Square.
 German Silver Protractor, No. 310, \$15 00



111.

111. Same instruments as No. 110, set in a tray, and box with lock and key, thus affording space for extra instruments or colors, 15 50
112. Polished Walnut Box, with lock and key and tray; containing pair 6 inch Dividers, with Pen, Pencil and Pen Point and Lengthening Bar, No. 73.
 Pair 5 inch plain Dividers, No. 66.
 Pair 5 inch Hair Spring Dividers, No. 70.
 Pair 3 inch Dividers, with Pen, Pencil and Needle Point, No. 72.
 Bow Pen, No. 82.
 2 Drawing Pens, No. 89.
 1 Red Ink Pen, No. 91.
 1 Road Pen, No. 93.
 Pair Proportional Dividers, No. 75 $\frac{1}{2}$.
 Protractor, No. 311.
 Triangle, No. 565.
 Triangular Scale, No. 463 or 466, 26 00
113. Same as No. 112, with addition of Beam Compass, No. 80, 31 00



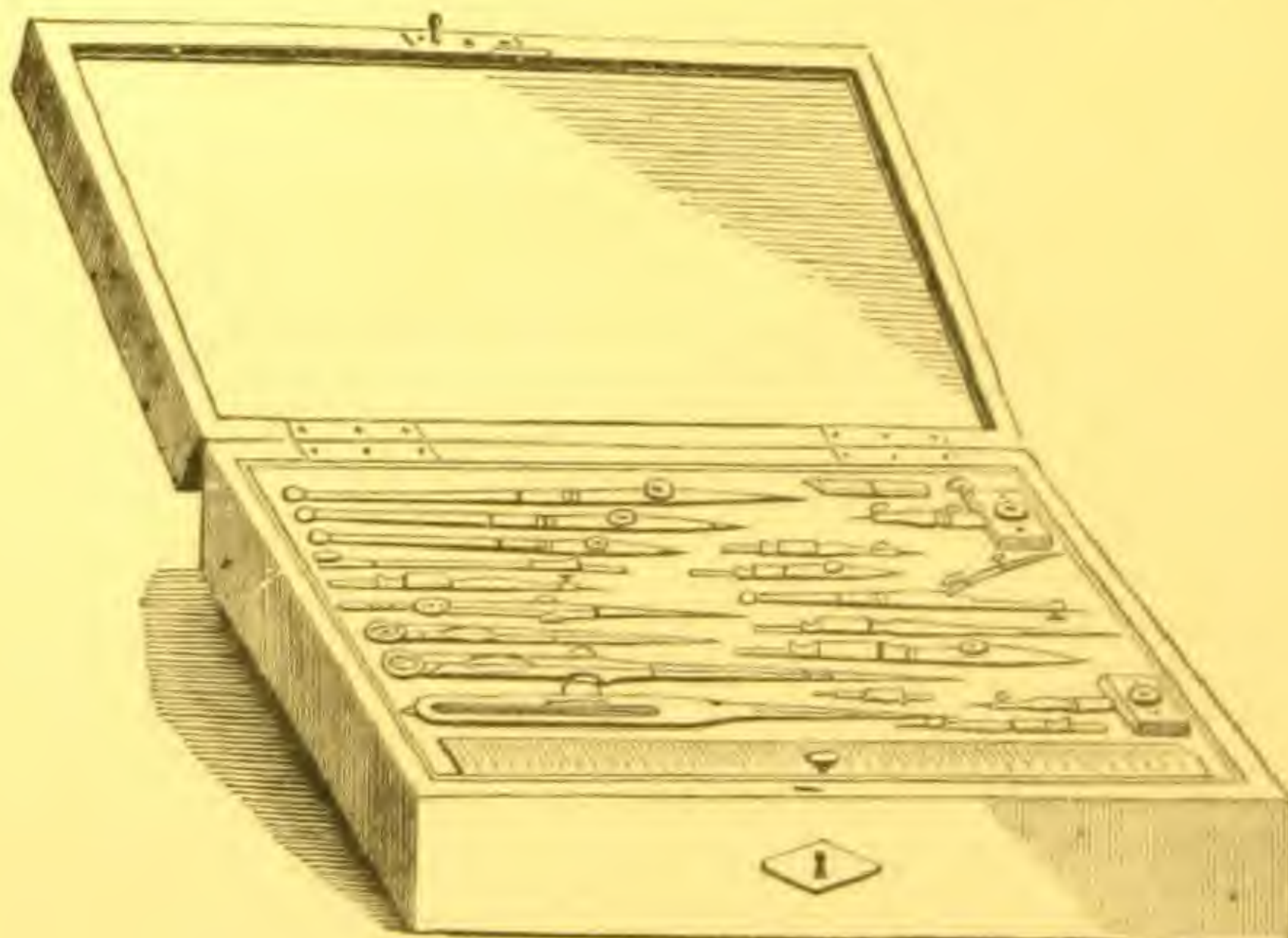
114

No.

PRICE

114. Polished Rosewood Box, inlaid, lock and key, with tray, leaving space below for paints, rules, &c.; containing pair 6½ inch Needle Point Dividers, with Pen, and Pencil Points and Lengthening Bar.
 Pair 4½ inch plain Dividers.
 Pair of 4 inch Needle Point Dividers, with Pen and Pencil Points.
 Pair of 7 inch Proportional Dividers.
 3 Drawing Pens.
 Horn Protractor.
 1 Wood Curve and 2 Wood Squares.
 Spring Bow Pen.
 Ivory Rule, 8 inches long.

\$27 00

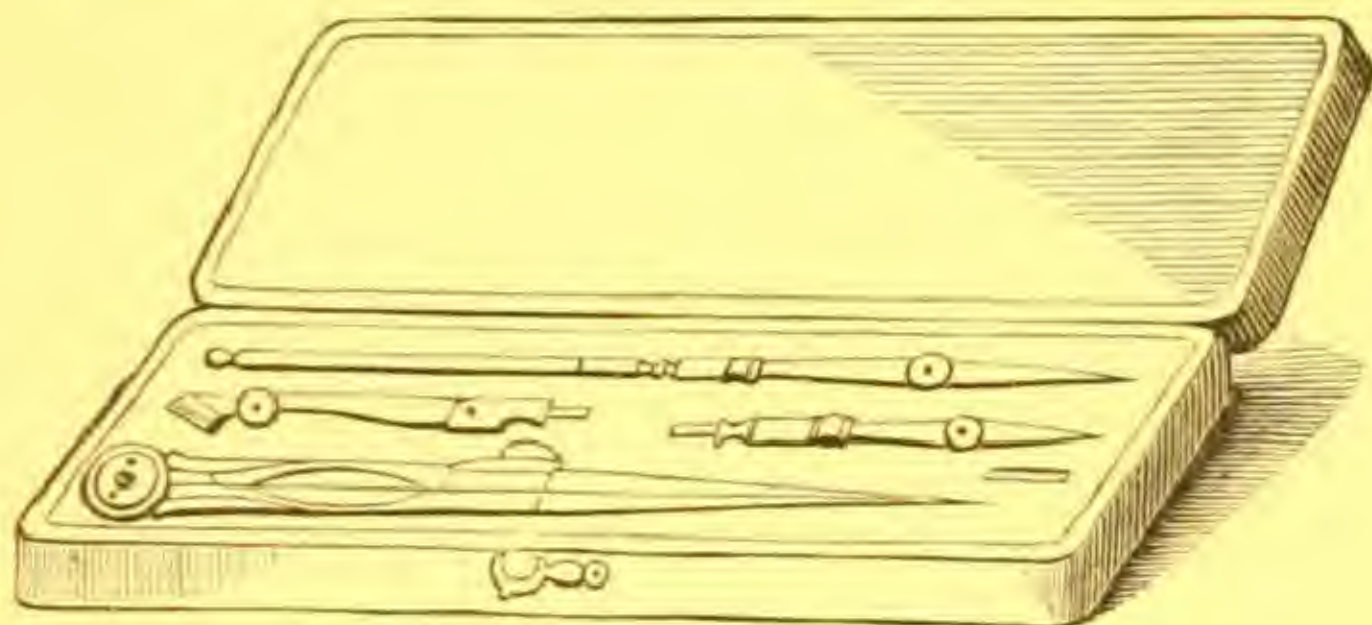


116.

No.

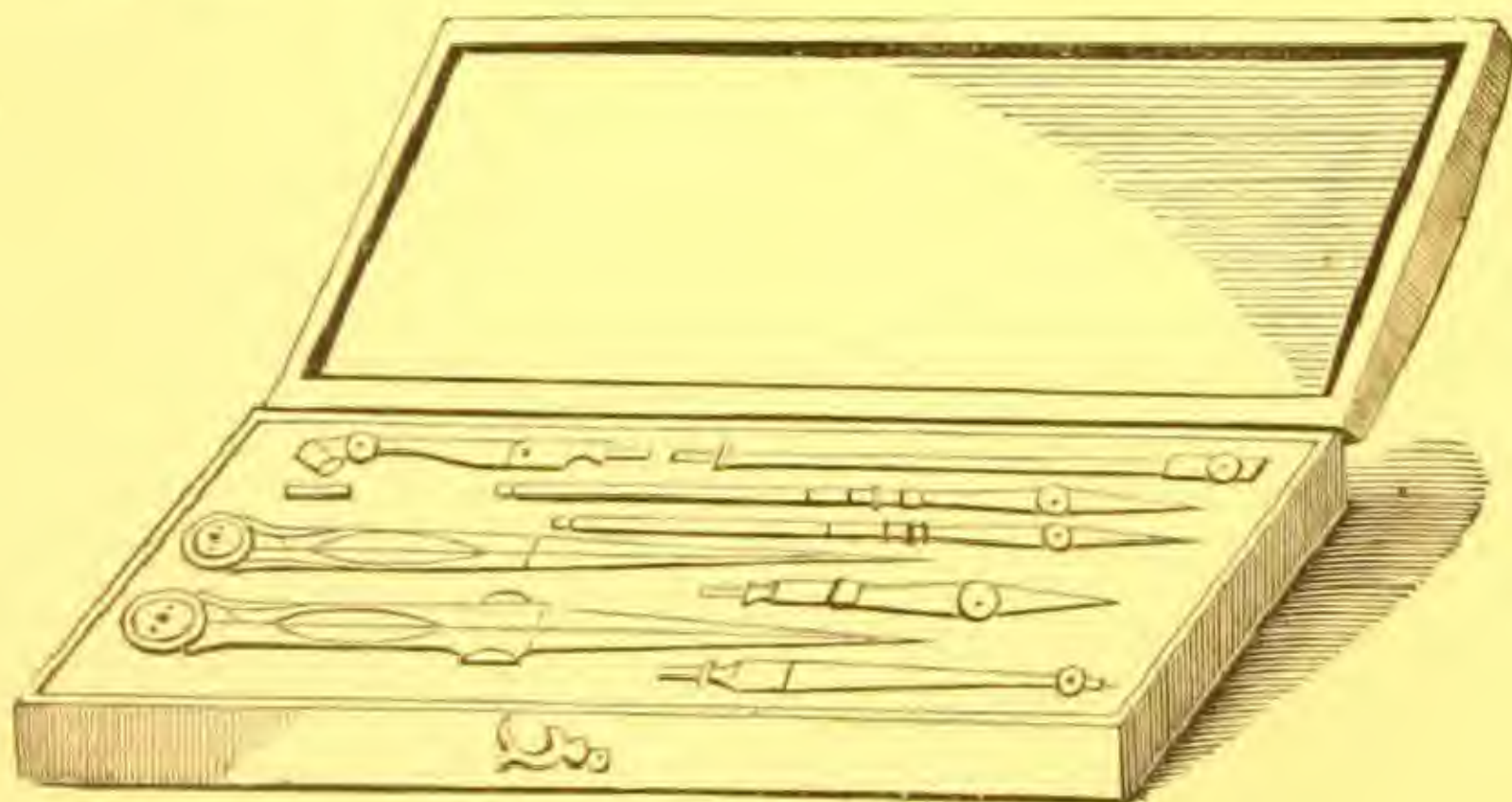
116. Polished Rosewood Box, inlaid, with brass edges, lock and key, with tray, leaving space below for paints, rules, &c.; containing pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar.
 Pair $4\frac{1}{2}$ inch plain Dividers, rounded points.
 Pair of 4 inch Dividers, Needle Points, with Pen and Pencil Points.
 Pair of $7\frac{1}{2}$ inch Proportional Dividers.
 Spring Bow Pen, Needle Point.
 3 Drawing Pens.
 Furniture for Beam Compass, with Micrometer Screw.
 9 inch Horn Protractor.
 Ivory Scale, 8 inches long, one edge divided to inches and eighths, the other to centimeters and millimeters, \$34 00

CASES OF SECOND QUALITY GERMAN SILVER INSTRUMENTS.



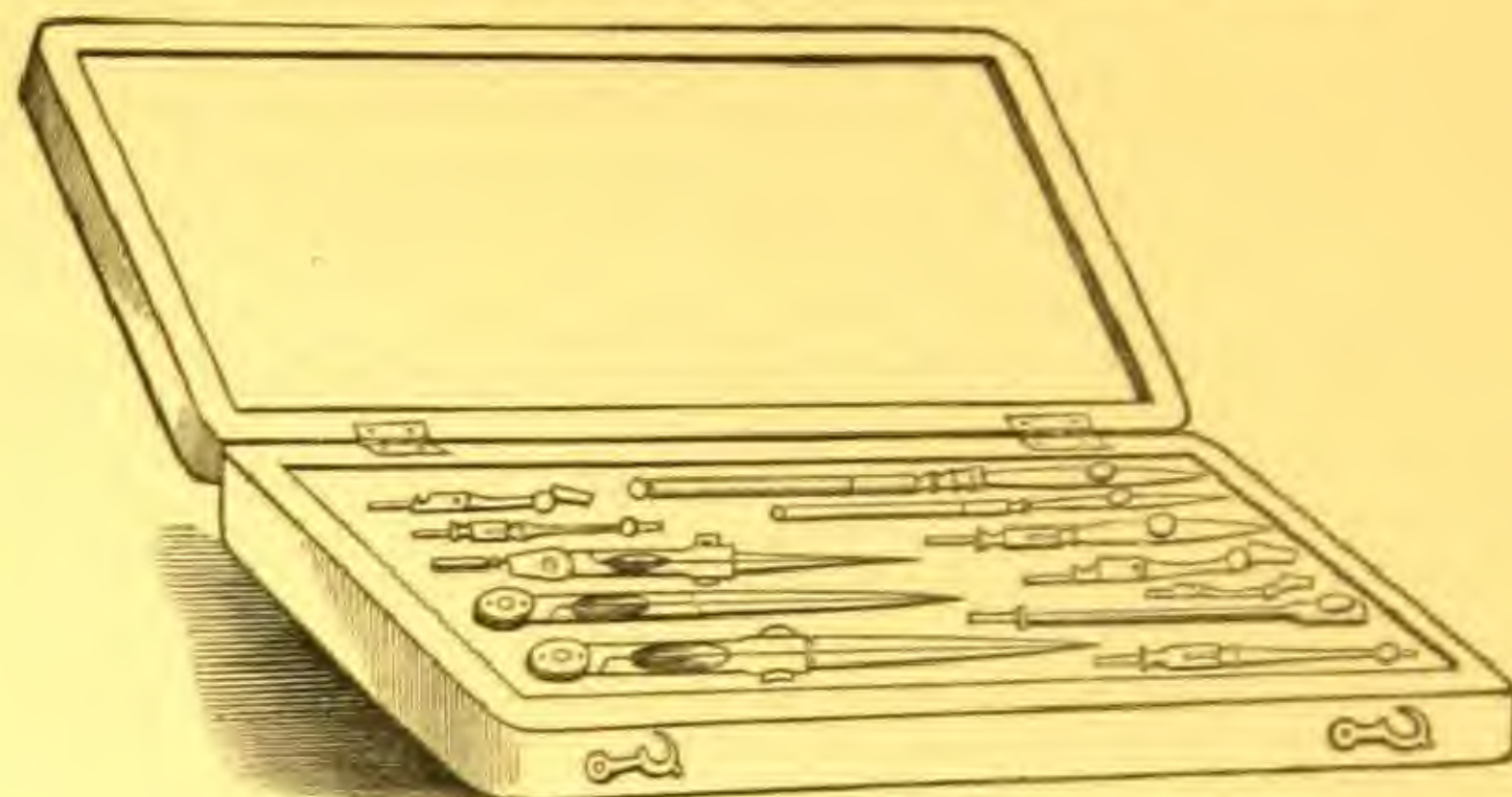
125.

125. Morocco Box; containing pair of $5\frac{1}{4}$ inch Dividers, with Pen and Pencil Points.
 Drawing Pen, \$2 00
 126. Morocco Box; containing pair of $5\frac{1}{4}$ inch Dividers, with Pen and Pencil Points and Lengthening Bar.
 Pair of 5 inch plain Dividers.
 Drawing Pen, 3 00



127.

127. Morocco Box; containing pair of $5\frac{1}{4}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar.
 Pair of 5 inch plain Dividers.
 2 Drawing Pens, 4 00



No.

128.

PRICE.

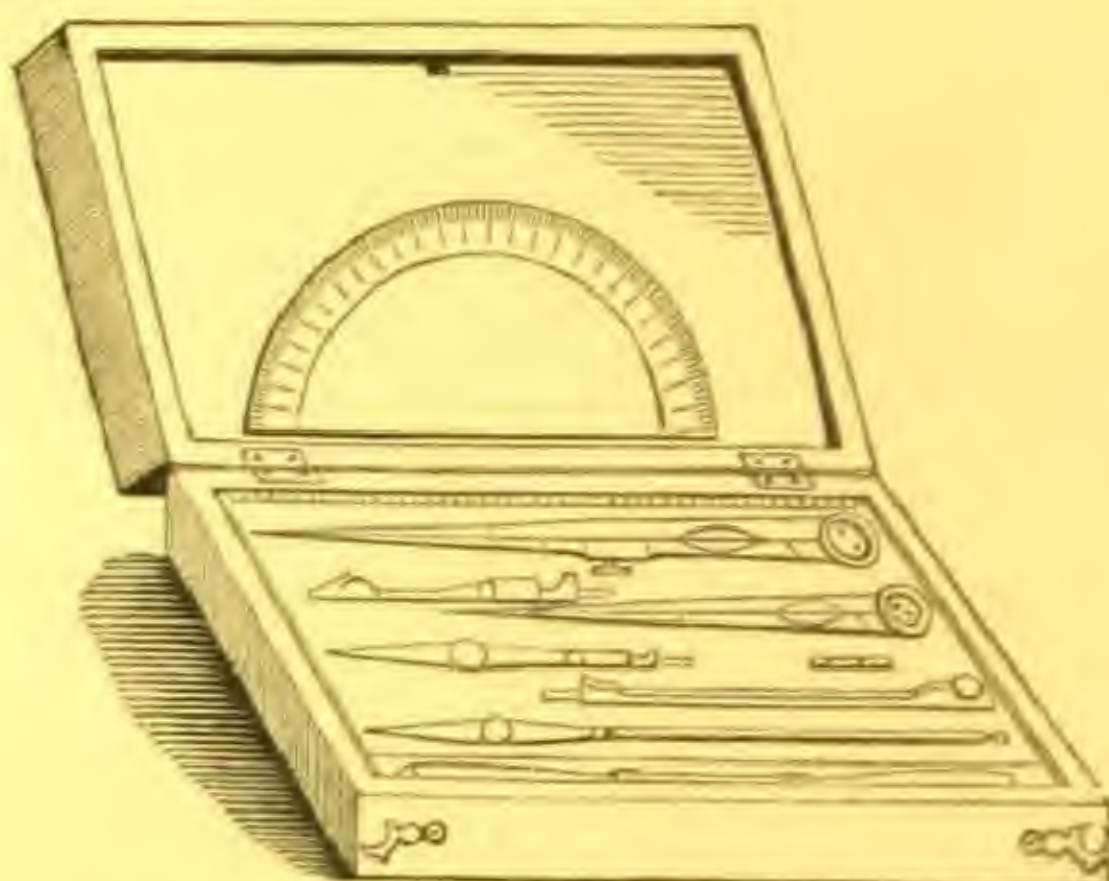
128. Morocco Box ; containing pair of $5\frac{1}{2}$ inch Dividers, with Pen, Pencil and Needle Points and Lengthening Bar.

Pair of 5 inch plain Dividers.

Pair of 4 inch Dividers, with Pen, Pencil and Needle Points.

2 Drawing Pens,

\$6 50



129.

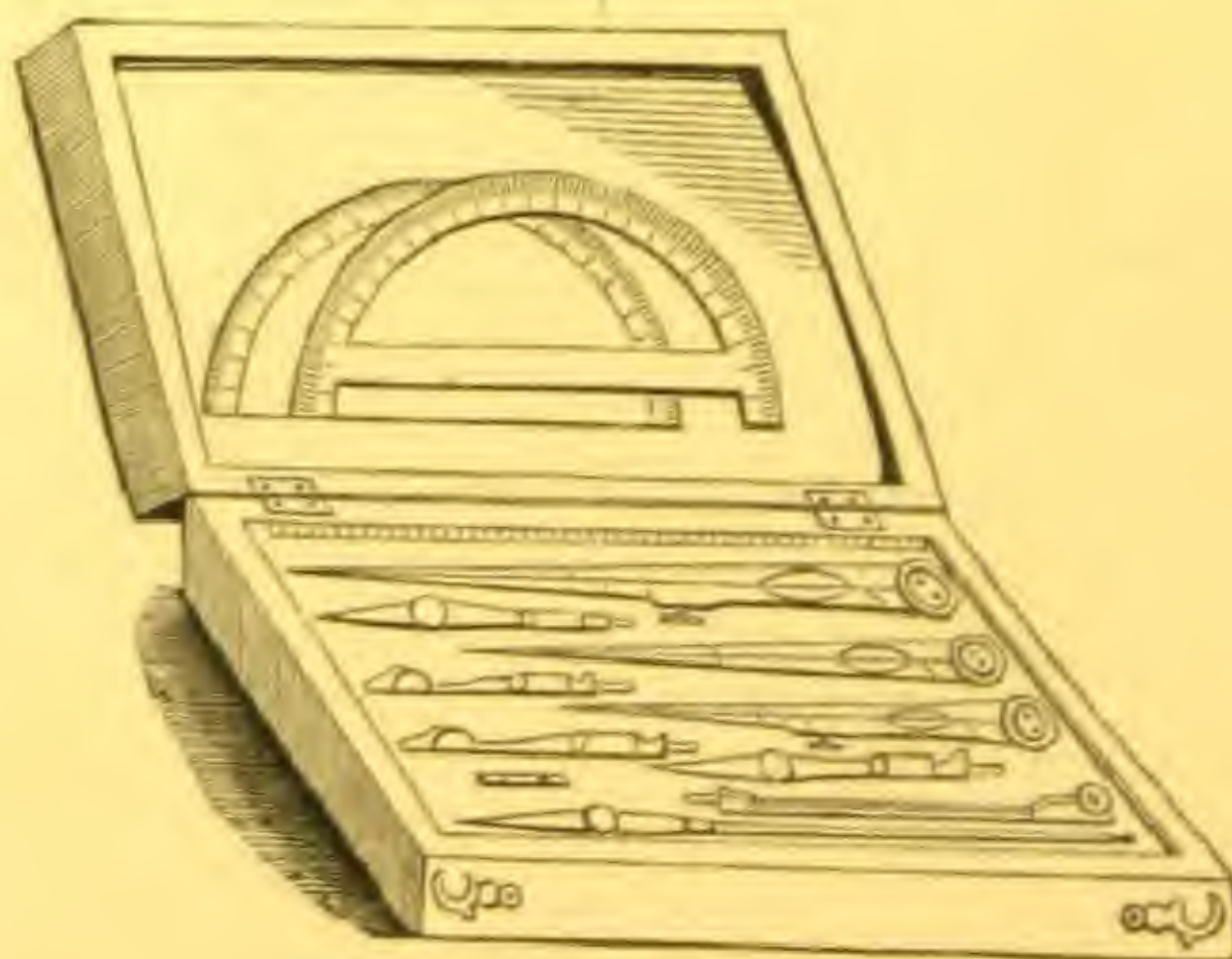
129. Rosewood Box ; containing pair of $5\frac{1}{2}$ inch Dividers, with Pen and Pencil Points and Lengthening Bar.

Pair of $4\frac{1}{2}$ inch plain Dividers.

Drawing Pen.

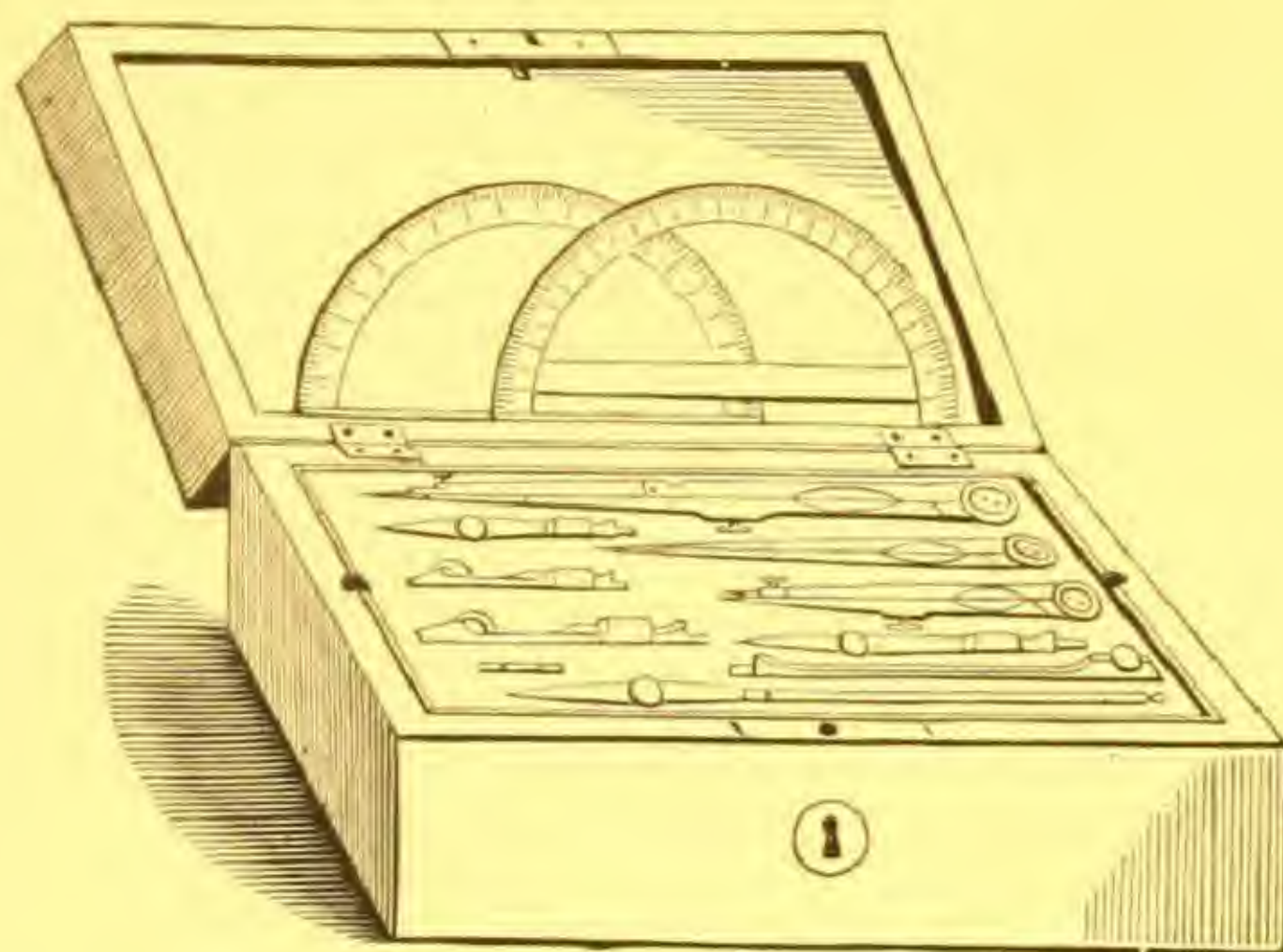
Horn Protractor,

3 50



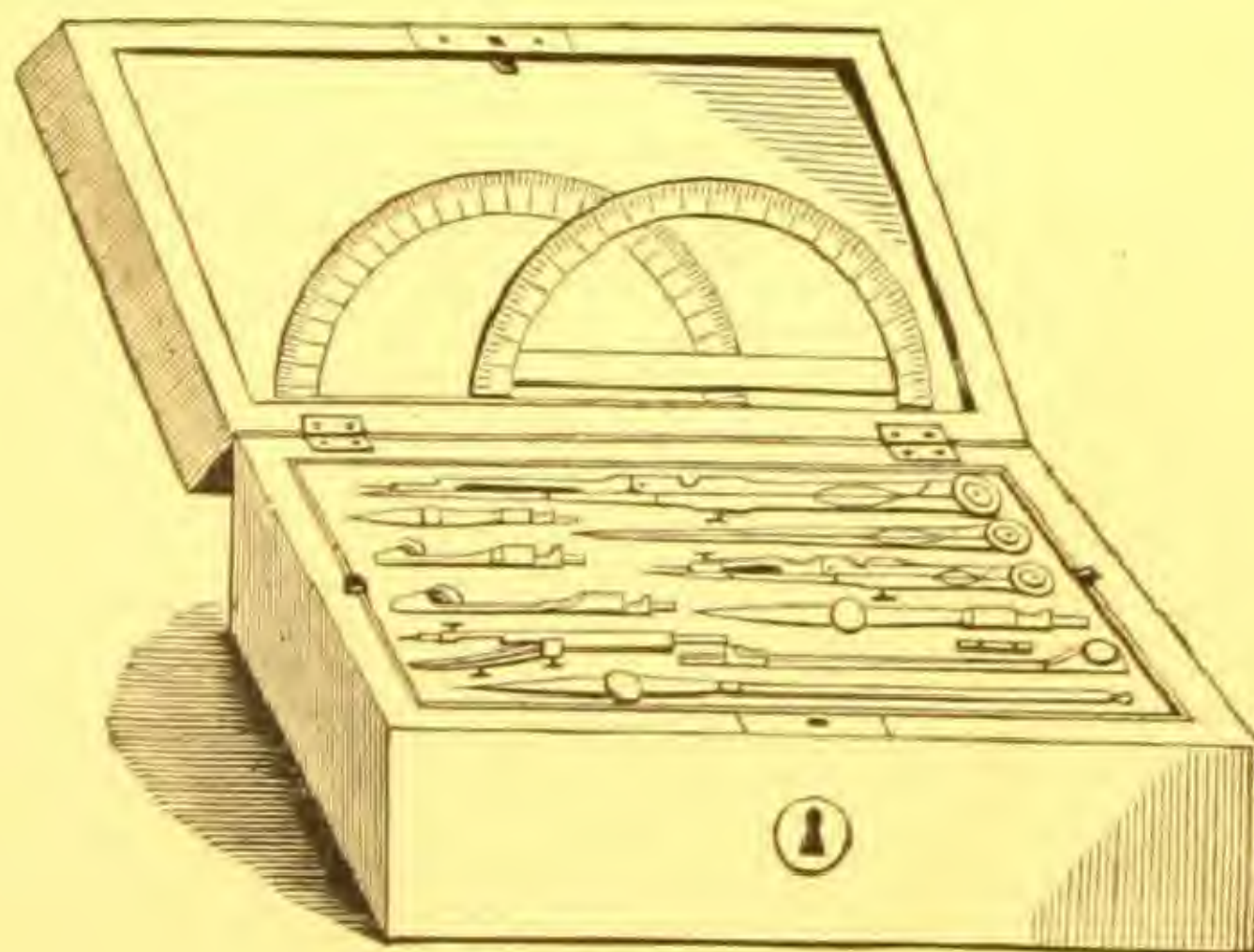
130.

- | | | |
|------|--|--------|
| No. | | |
| 130 | Rosewood Box; containing pair of 6 inch Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of $4\frac{1}{2}$ inch plain Dividers.
Pair of $3\frac{1}{2}$ inch Dividers, with Pen and Pencil Points.
Drawing Pen.
Brass Protractor.
Horn Protractor. | \$5 00 |
| 131. | Same as No. 130, but with the instruments set in a tray, so that colors, &c., may be put below, | 6 00 |



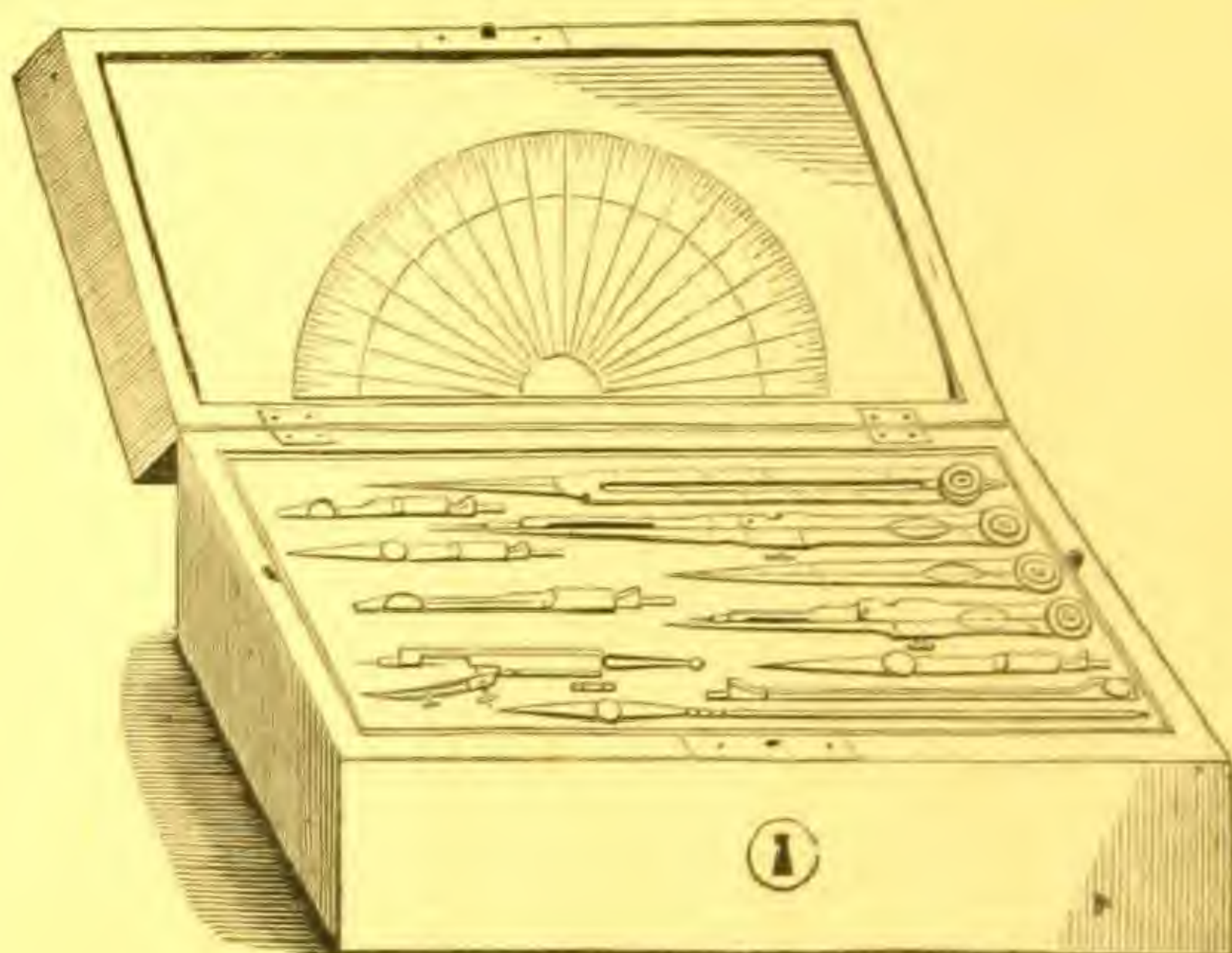
132.

- | | | |
|------|--|-------|
| 132. | Rosewood Box, with lock and key and the instruments set in a tray, so that colors, &c., may be put below; containing pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of $4\frac{1}{2}$ inch plain Dividers.
Pair of $3\frac{1}{2}$ inch Needle Point Dividers, with Pen and Pencil Points.
Drawing Pen.
Brass Protractor.
Horn Protractor, | 6 75. |
|------|--|-------|



133.

No.	Price
133. Rosewood Box, with lock and key, the instruments set in a tray, so that colors, &c., may be put below; containing pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar. Pair of 4½ inch plain Dividers. Pair of 3½ inch Needle Point Dividers, with Pen and Pencil Points. Spring Bow Pen, with Needle Point. Drawing Pen. Brass Protractor. Horn Protractor.	\$7 50



134.

134. Rosewood Box, with lock and key, the instruments set in a tray, so that colors, &c., may be put below; containing pair of 6 inch Needle Point Dividers, with Pen and Pencil Points and Lengthening Bar. Pair of 4½ inch plain Dividers. Pair of 3½ inch Needle Point Dividers, with Pen and Pencil Points. Spring Bow Pen, with Needle Point. Drawing Pen. German Silver Protractor. Horn Protractor. Irregular Curve of Wood. 2 Triangles of Wood. Pair Proportional Dividers, 7½ inches long,	10 75
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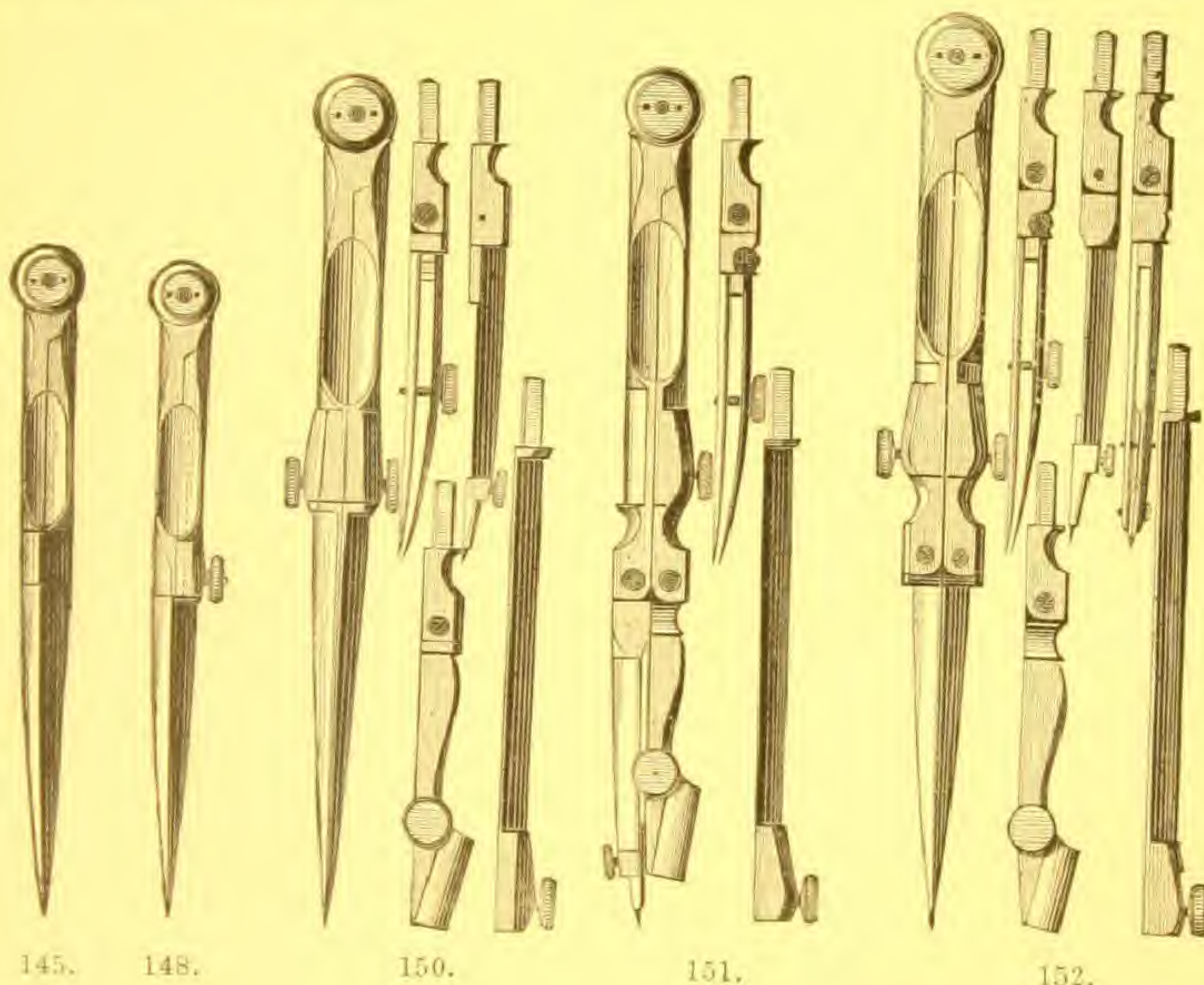
CHAPTER III.

JAMES W. QUEEN & CO. ARE SOLE AGENTS BY APPOINTMENT IN
PHILADELPHIA, AND PRINCIPAL AGENTS IN THE
UNITED STATES, FOR THE

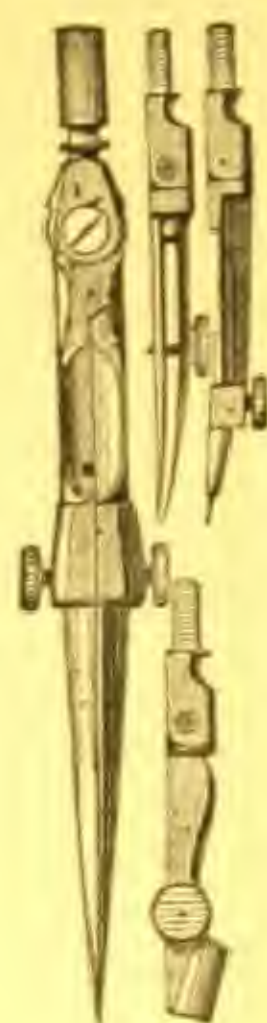
CELEBRATED SWISS DRAWING INSTRUMENTS.

Although there are several makers of drawing instruments in Switzerland, yet there is but one manufacturer whose instruments uniformly come up to a standard of absolute perfection in quality of material and excellence of finish. The divider joints work regularly and smoothly, the points are carefully tempered and rounded, the pens dressed to draw a smooth line of any thickness in whatever position held.

Other Swiss manufacturers imitate the form of these instruments, but cannot imitate their perfection in finish.



No.	Price.
145. Plain Dividers, $4\frac{1}{2}$ inches long, each,	\$1 90
146. Plain Dividers, 5 inches long, each,	2 25
147. Plain Dividers, 6 inches long, each,	2 70
148. Hair Spring Dividers, $4\frac{1}{2}$ inches long, each,	2 65
149. Hair Spring Dividers, 5 to 6 inches long, each,	3 00
150. Dividers, $6\frac{1}{2}$ inches long, with Pen, Pencil, Needle Points and Lengthening Bar,	8 50
151. Dividers, $6\frac{1}{2}$ inches long, with fixed Needle Point and Loose Pen, and Pen Points and Lengthening Bar,	6 75
152. Dividers, $6\frac{1}{2}$ inches long, joints in each leg, with Pen, Pencil, Needle Points, Dotting Pen and Lengthening Bar,	11 00



153.



154.



154 1/2.

No.	Price.
153. Dividers, 4 inches long, with Pen, Pencil and Needle Points,	\$6 00
154. Dividers, 4 inches long, with fixed Needle Point, and Pen and Pencil Points, changeable,	5.25
154 1/2. Fox's Patent Lead Holder for pencil leg of Dividers, . . . . .	.25



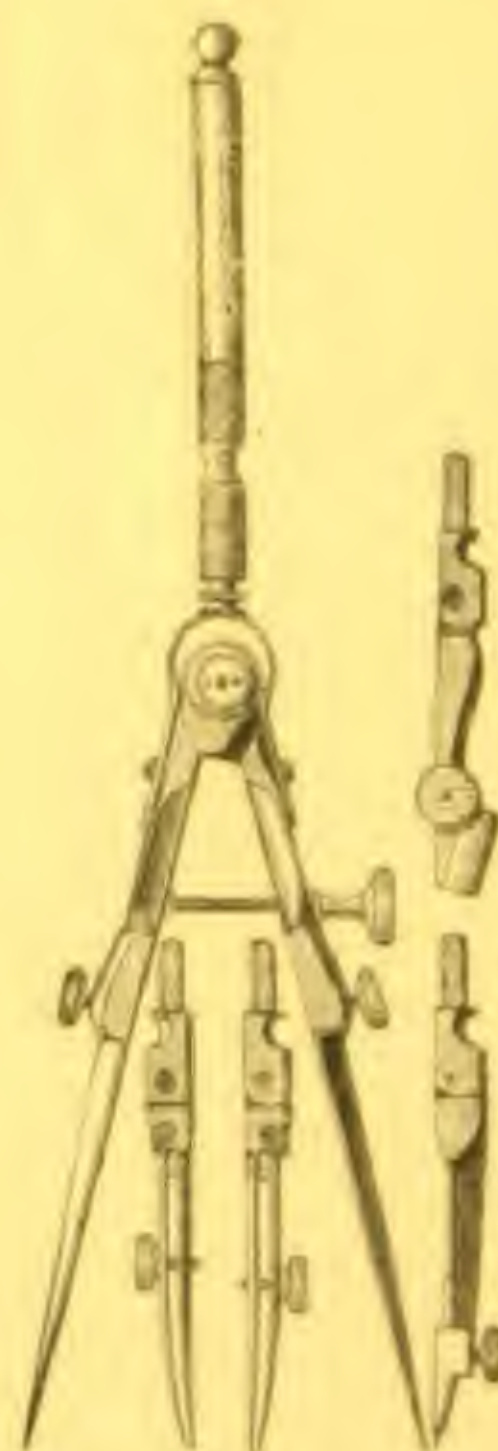
155.



156.

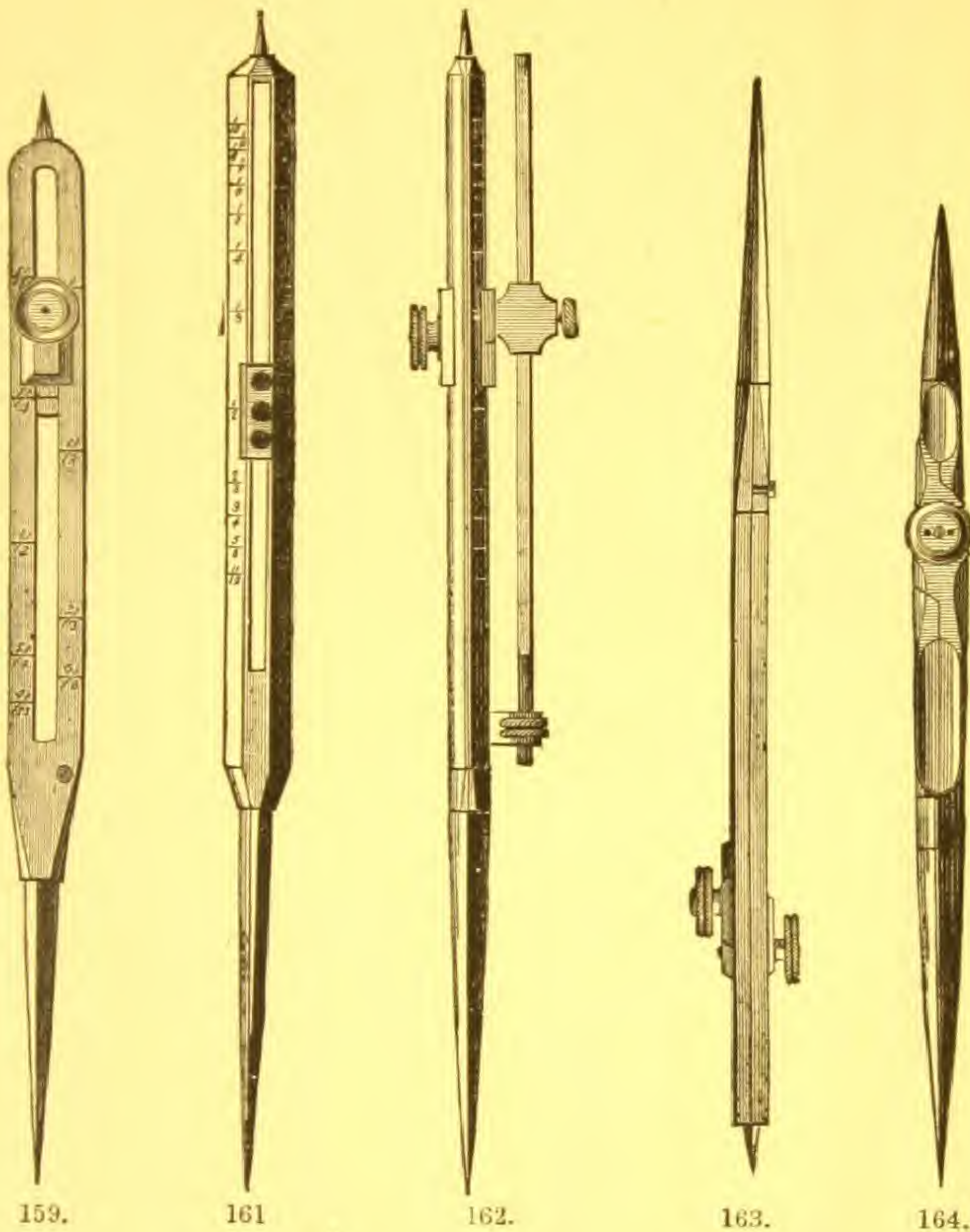


157.



158.

155. Dividers, 4 inches long, with two fixed Needle Points,	3 25
156. Dividers, 4 inches long, with fixed Needle Point and Pen Point,	3 60
157. Dividers, 4 inches long, with fixed Needle Point and Pencil Point,	3 60
158. Dividers, 4 inches long, with Spring and Set Screw, Needle Point, Pencil Point and two Pen Points,	8 50



No.		PRICE.
159.	Proportional Dividers, $6\frac{1}{2}$ inches long, finely graduated for lines,	\$8 75
160	Proportional Dividers, $6\frac{1}{2}$ inches long, finely graduated for lines and polygons,	10 00
161	Proportional Dividers, 9 inches long, finely graduated for lines and polygons,	12 25
162.	Proportional Dividers, 9 inches long, with micrometer adjustment, finely graduated for lines and polygons,	14 75
163.	Proportional Dividers, 8 inches long, with rack adjustment, graduated for lines,	12 75
164.	Bisecting Dividers, $7\frac{1}{2}$ inches long, each,	4 30

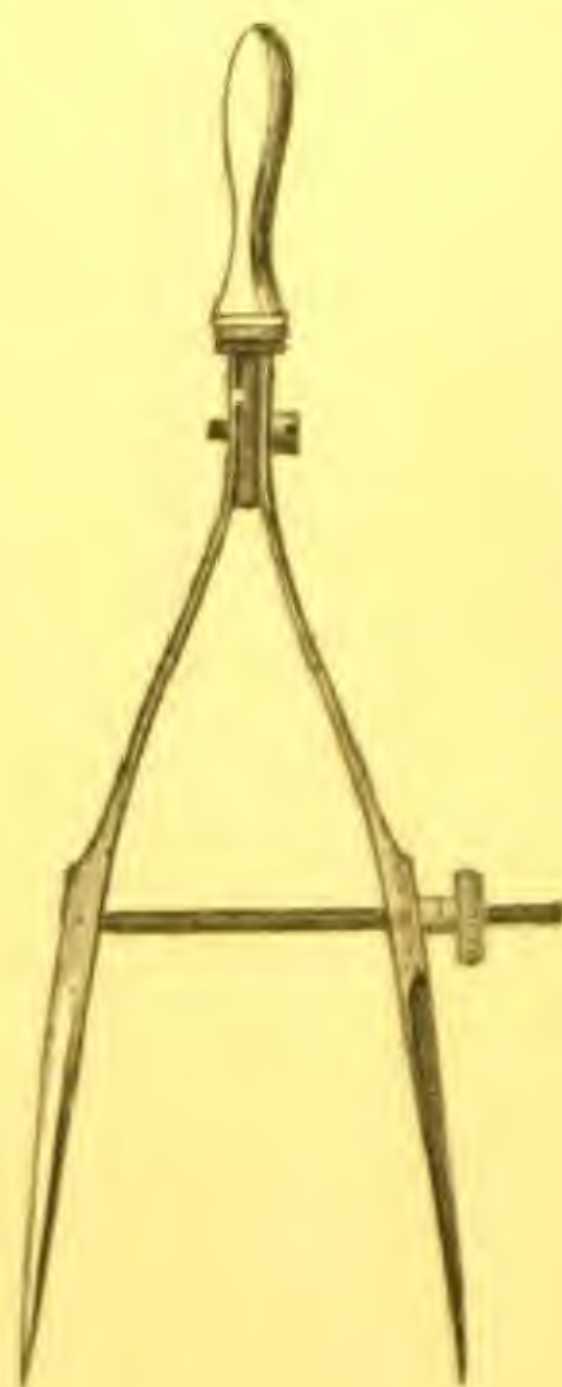


165.



166.

No.		PRICE.
165.	Pocket Dividers, 5 to 6 inches long, with sheath, each,	\$3 00
166.	Three-Legged Dividers, 5 to 6 inches long, each,	5 25



167.



168.

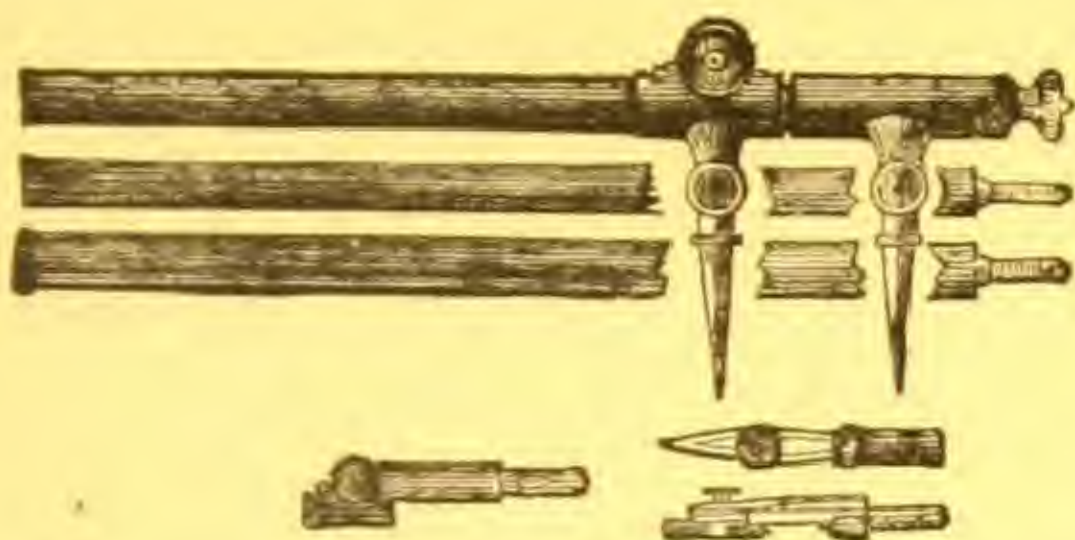


168 1/2.

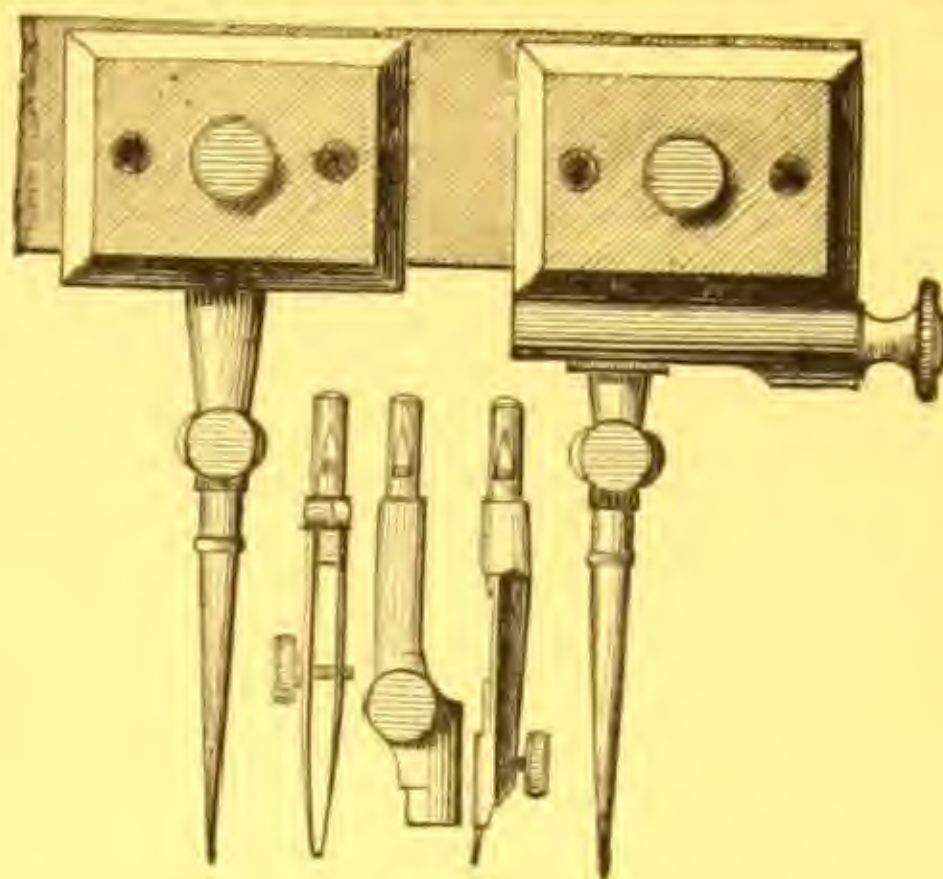


169.

167.	Steel-Spacing Dividers, 5 inches long, with Ivory Handle,	3 20
168.	Do. do. 3 1/4 do. with Ivory or Metal Handle,	1 70
168 1/2.	Very delicate Steel-Spacing Dividers, 2 1/2 inches long,	1.70
169.	Steel-Spacing Dividers, 3 1/2 inches long, with Ivory Handle and Needle Points,	3.00



171.



174.

No.							Price.
170.	Beam Compass, 20 inches long, in 2 bars, with Pen, Pencil, and two Straight Points,						\$11 50
171.	Beam Compass, 21 inches long, in 3 bars,						13 00
172.	Do.	36	do.	4 do.			19 00
173.	Do.	54	do.	4 do.			22 50
174.	Furniture for Wood Bar Beam Compasses, in morocco box,						8 75

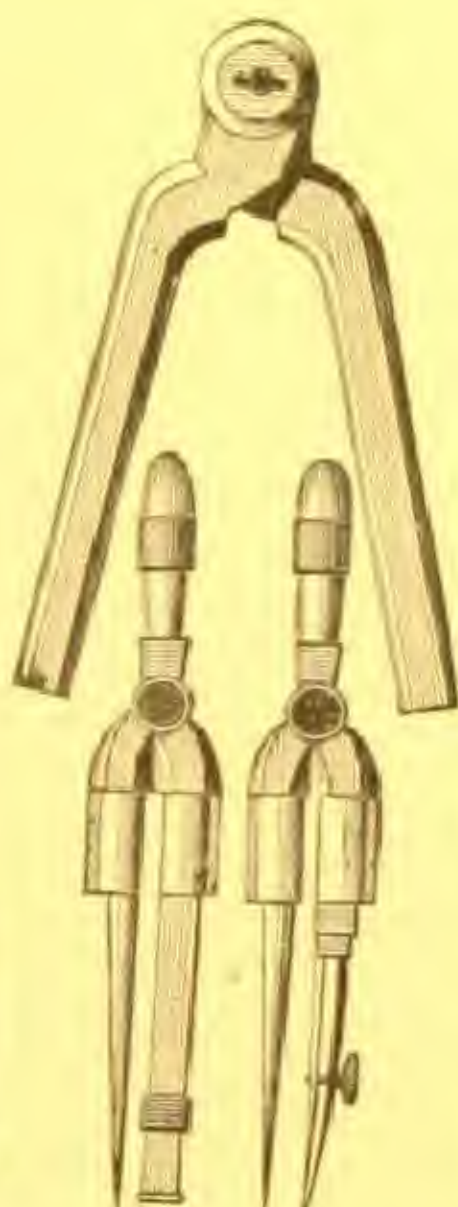


174½

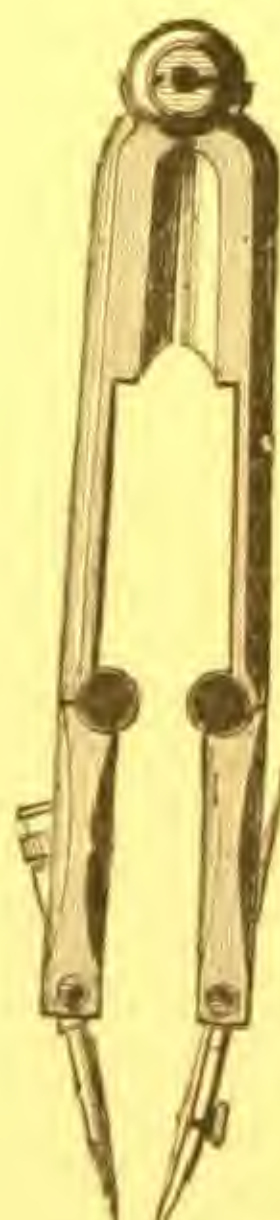
174½.	Hardwood Bars for Beam Compasses,						
	24	30	36	42	48	60 inch.	
each,	35	40	45	55	65	75 cents.	



179.



180.



181.



No.	PRICE.
175. Furniture for Wood Bar Beam Compasses, not in morocco box, . . .	\$8.30
179. Pillar Compasses, or Pocket Set of Instruments, with Points to change, . . .	8 50
180. Pillar Compasses, or Pocket Set of Instruments, with Points to change, and Handles to Bow Pen and Pencil, . . .	10 00
181. Pillar Compasses, or Pocket Set of Instruments, with Points to turn, . . .	9 00



182.



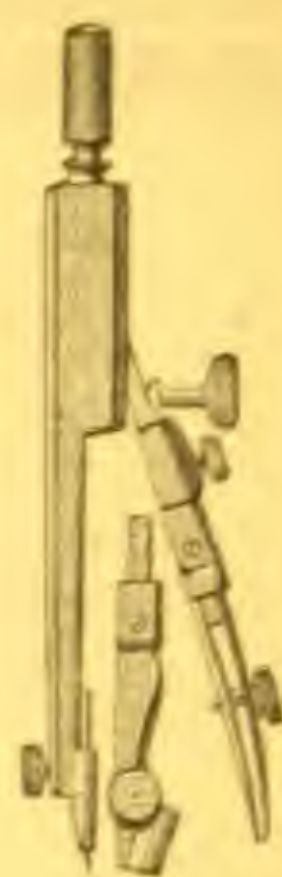
182½.



183.



184.



185.

182. Spring Bow Pen, all steel, Ivory Handle, . . .	2.25
182½. Very delicate Steel Bow Pen, 2½ inches long, . . .	2.25
183. Spring Bow Pen, with Needle Point, all steel, Ivory Handle, . . .	3.00
184. Do. do. German Silver, . . .	2 65
185. Do. do. do. with Pencil Point, . . .	3 60



186.



186½.



187.



188.



189.

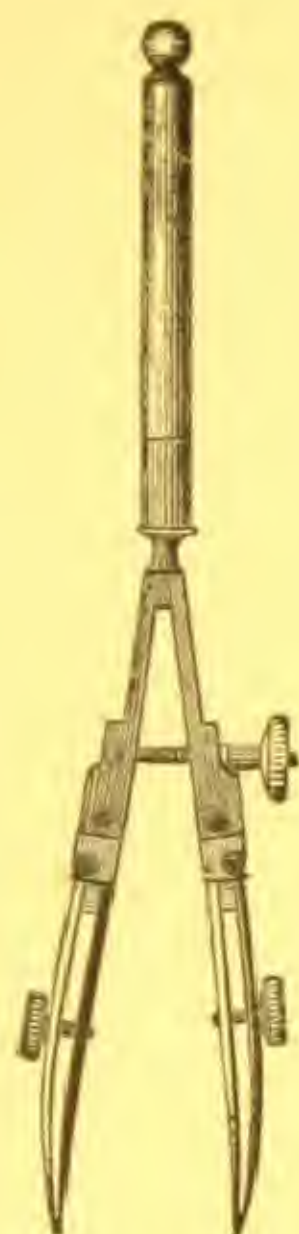


190.

186. All Steel Spring Bow Pencil, Ivory Handle, . . .	2.25
186½. Very delicate Steel Bow Pencil, 2½ inches long, . . .	2.25
187. All Steel Spring Bow Pencil, Ivory Handle, Needle Point, . . .	3.00
188. Drawing Pen, 4½ inches long, with joints, . . .	1.60
189. Do. 5½ do. do.	1.70
190. Do. 6½ do. do.	1.95



191.



192.



193.



195.

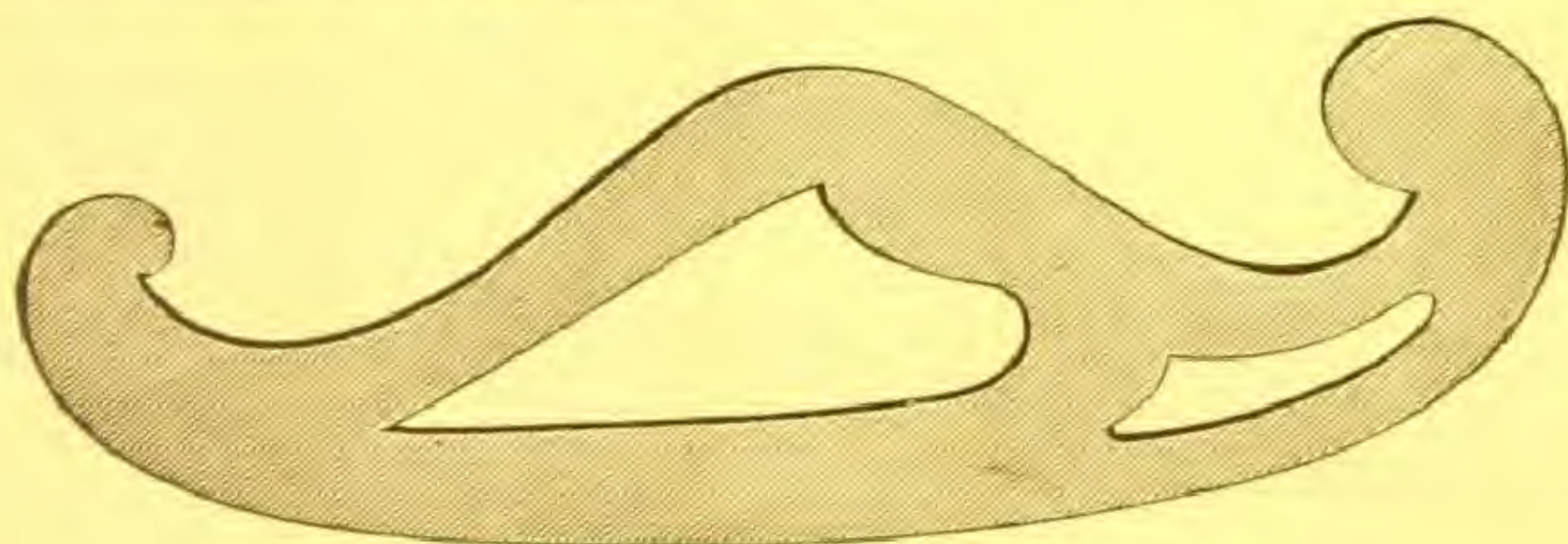


196.

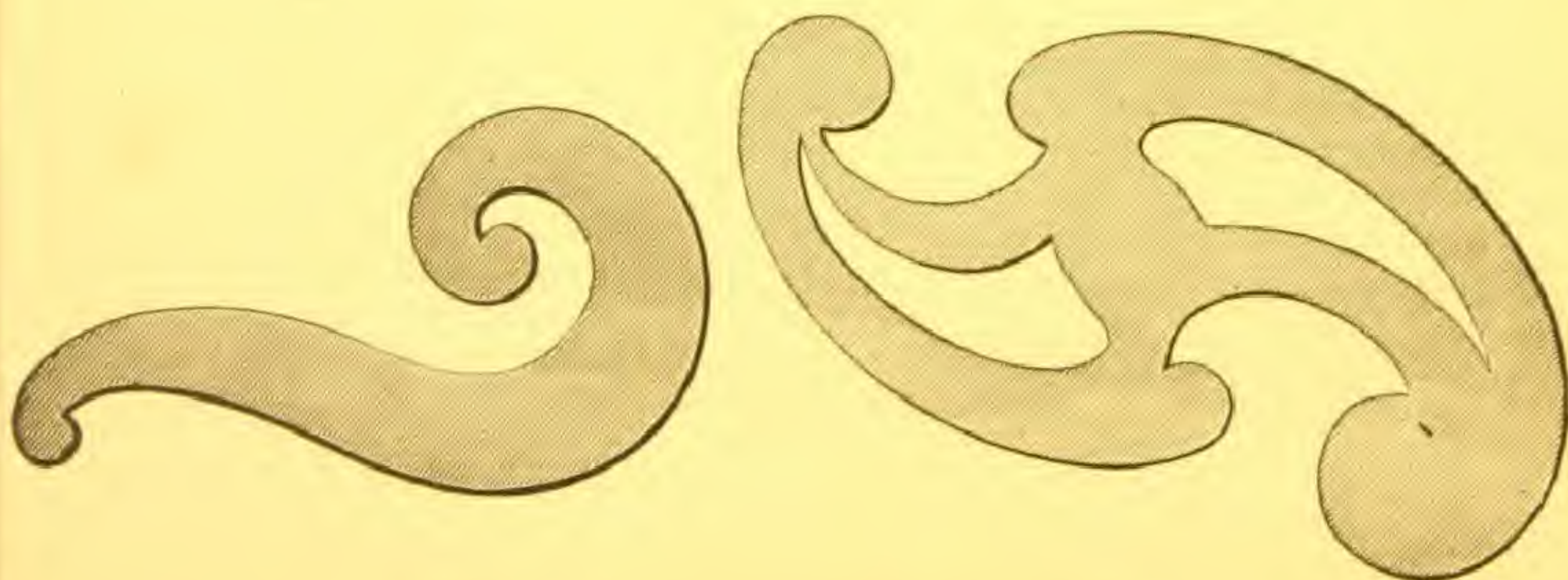


197.

No.		PRICE.
191.	Road, or Double Drawing Pen,	\$4 15
192.	Do. do. do. with joint in each side,	3 80
193.	Dotting Pen, with one wheel,	2 65
194.	Do. with six wheels,	4 00
195.	Horn Centre, with German Silver edges,	50
196.	German Silver Centre, with handle,	30
197.	Do. Fastening Tacks, per dozen,	80
198.	Steel Fastening Tacks, per dozen,	80



199A.



199B.

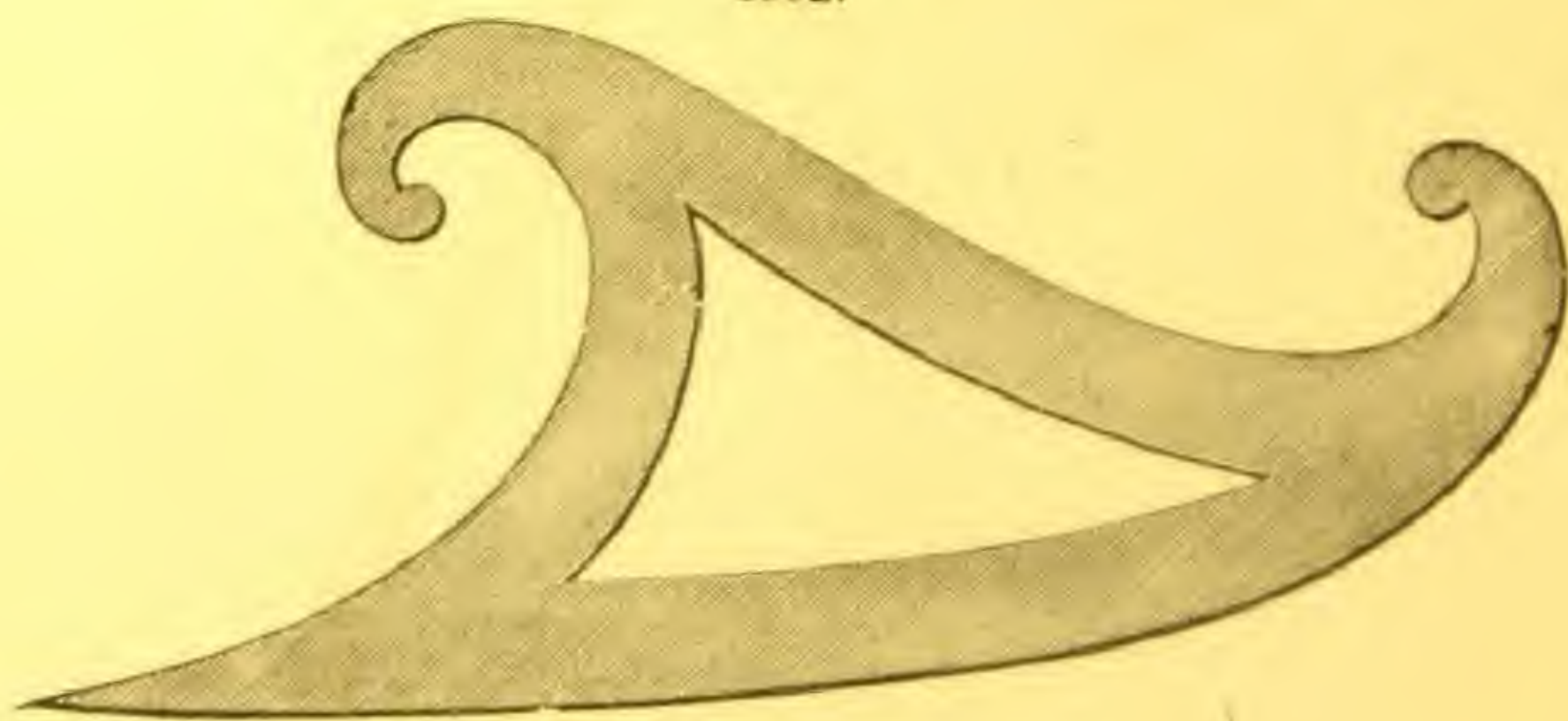
199C.



199D.

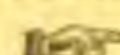


199E.



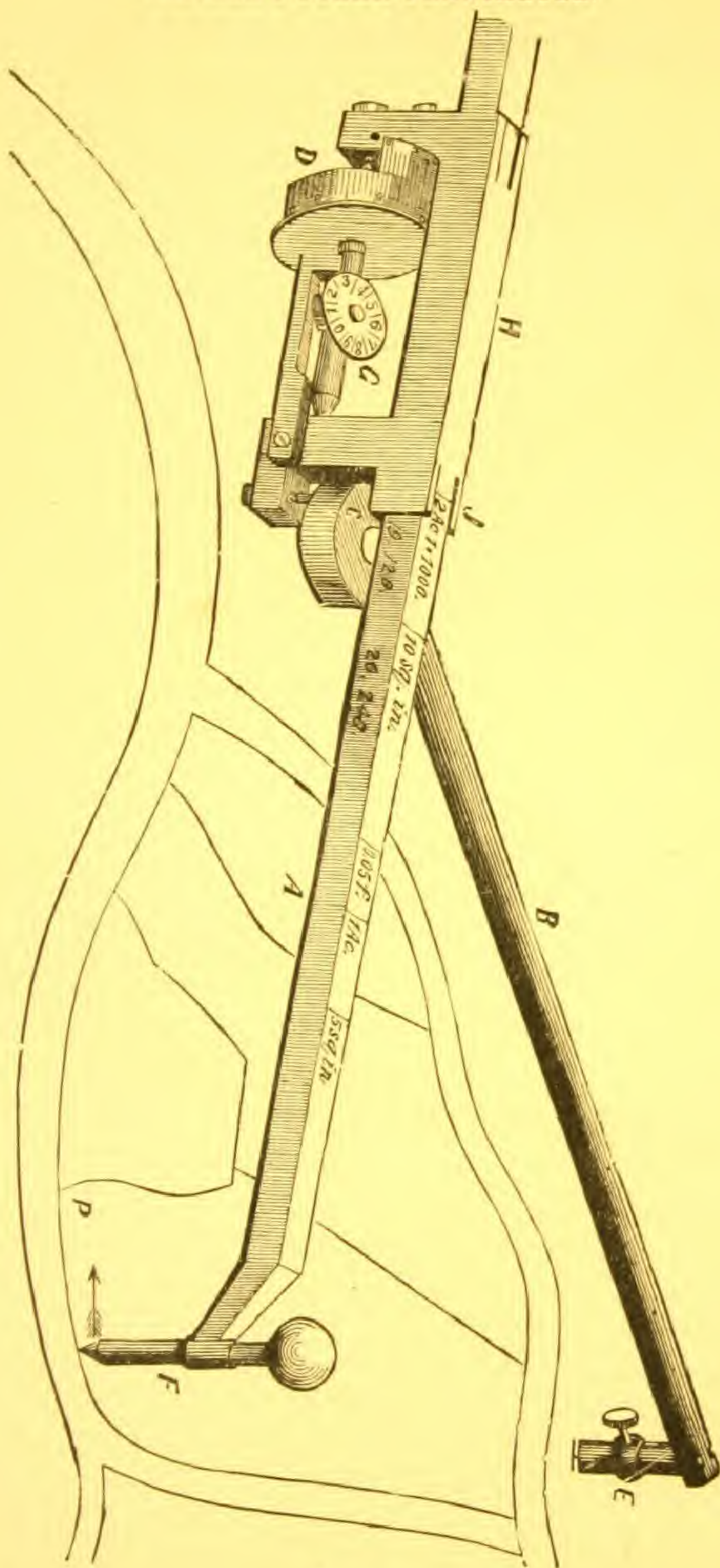
199F.

No.		PRICE.
199.	Irregular Curves of Horn, each,	\$0 75
200.	Rolling Parallel Rule, ebony,	3 75
201.	Polar Planimeter, with printed instructions,	80 00
202.	Eccentric Rule, 11 inches long,	2 65
203.	Steel Needle Points for Divider Legs, each,	.15
204.	Tracer, with Ivory Handle, each,	1.50
205.	Pricker, with Ivory Handle, each,	2.00

 For Boxwood and Ivory Scales, Protractors, &c., &c., see pages 38 to 42.

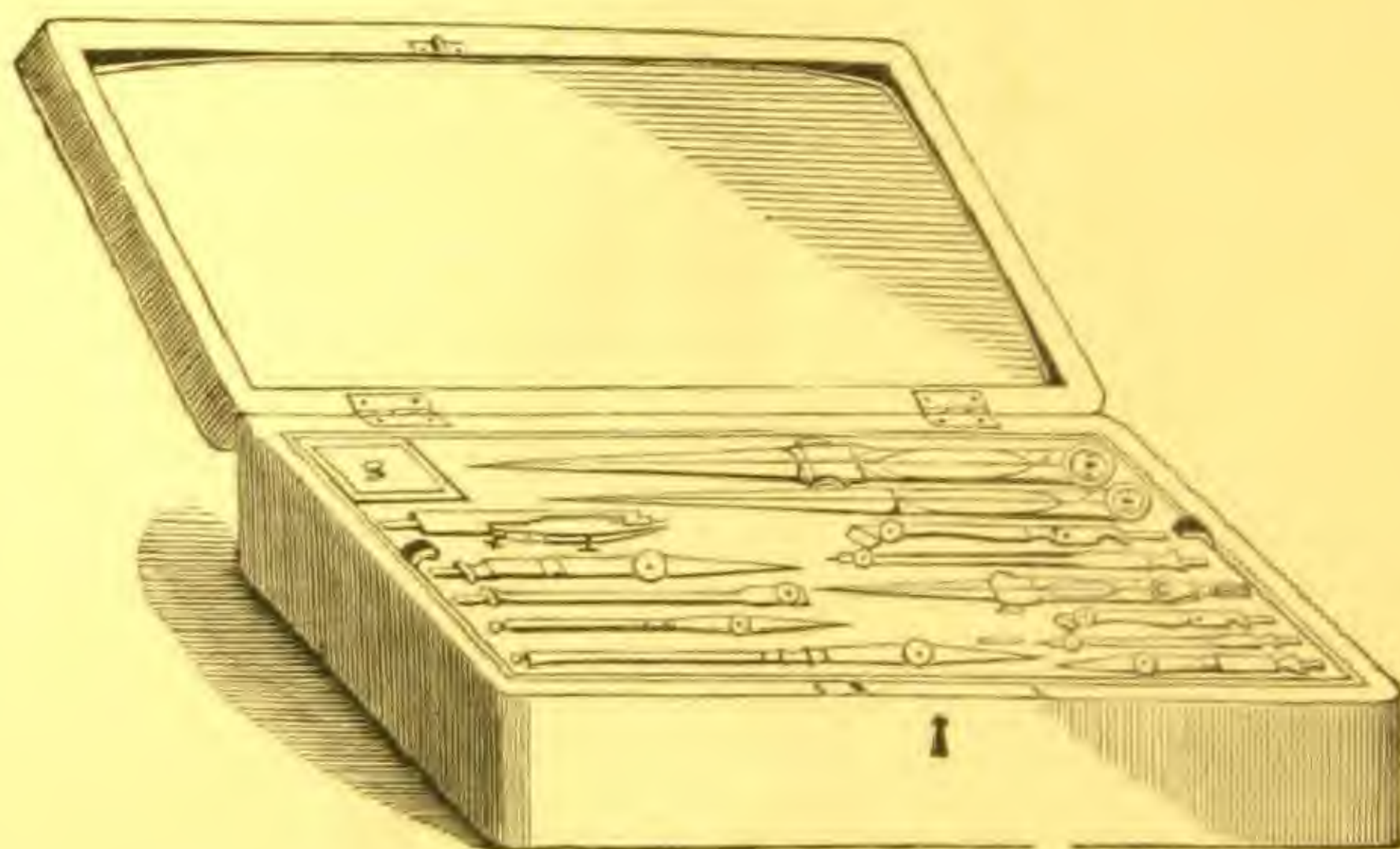
Parties wanting cases made up of these Instruments, can select the pieces, by the above list, that are best adapted to their purpose, and we will have boxes made to suit, at an additional cost of from \$7 to \$15, according to the size of the boxes, which are made of rosewood, mahogany or walnut, highly finished.

AMSLER'S POLAR PLANIMETER.



SETS OF EXTRA FINE SWISS DRAWING INSTRUMENTS.

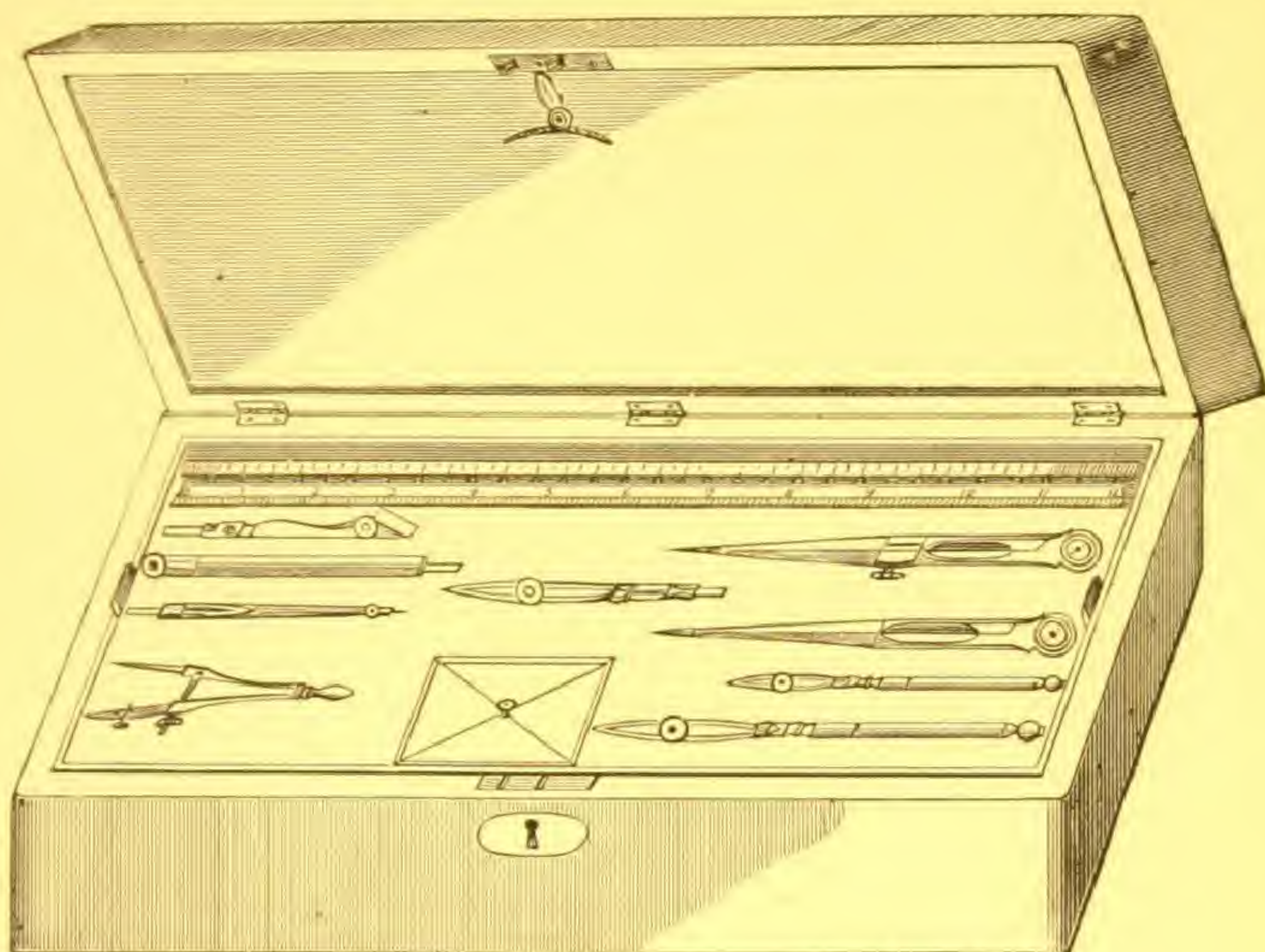
No.		PRICE.
	The following sets have beautifully finished Walnut Boxes, 9½ inches long by 6 inches wide, with lock and key and tray.	
250.	Contains pair plain Dividers, No. 146. Set of Instruments, No. 150. Steel Spacing Divider, No. 168. Steel Bow-Pen, No. 182. Steel Bow-Pencil, No. 186. Drawing Pen, No. 189. Triangular Scale, No. 464 or 467,	\$25 00
251.	Contains pair plain Dividers, No. 146. Set of Instruments, No. 150. Do. No. 153. Drawing Pen, No. 188. Do. No. 190. Triangular Scale, No. 464 or 467,	26 50



253.

253.	Contains pair plain Dividers, No. 146. Set of Instruments, No. 150. Do. No. 153. Bow Pen, No. 184. Drawing Pen, No. 188. Do. No. 190. Triangular Scale, No. 464 or 467,	29 00
254.	Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, No. 150. Steel Spacing Dividers, No. 168. Steel Bow Pen, No. 182. Steel Bow Pencil, No. 186. Drawing Pen, No. 188. Do. No. 190. Triangular Scale, No. 464 or 467,	30 00

No.	PRICE.
255. Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, Nos. 150 and 153. Bow Pen, No. 184. Drawing Pens, Nos. 188 and 190. Triangular Scale, No. 464 or 467,	\$33 00



260.

The following sets have beautifully finished Walnut Boxes, 13 inches long by 6 inches wide, with lock and key and tray.

260. Contains pair plain Dividers, No. 146. Set of Instruments, No. 150. Steel Bow Pen, No. 182. Drawing Pens, Nos. 188 and 189. Triangular Scale, No. 463 or 466,	23 00
261. Contains pair plain Dividers, No. 146. Set of Instruments, Nos. 150 and 153. Steel Bow Pen, No. 182. Steel Bow Pencil, No. 186. Drawing Pens, Nos. 188 and 189. Triangular Scale, No. 463 or 466,	31 50

The following sets have beautifully finished Rosewood Boxes, 13 inches long by 7½ inches wide, with lock and key and tray.

262. Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, Nos. 150 and 153. Pair Steel Spacing Dividers, No. 168. Steel Bow Pen, No. 182. Steel Bow Pencil, No. 186. Drawing Pens, Nos. 188, 189, and 190. Triangular Scale, No. 463 or 466,	39 00
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No.	PRICE.
263. Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, Nos. 150 and 153. Proportional Dividers, No. 159. Steel Spacing Dividers, No. 168. Steel Bow Pen, No. 182. Steel Bow Pencil, No. 186. Drawing Pens, Nos. 188, 189, and 190. Triangular Scale, No. 463 or 466,	\$49 00
264. Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, Nos. 150 and 153. Proportional Dividers, No. 160. Steel Spacing Dividers, No. 168. Steel Bow Pen, No. 182. Steel Bow Pencil, No. 186. Beam Compass, No. 171. Drawing Pens, Nos. 188, 189, and 190. Road Pen, No. 192. Dotting Pen, No. 193. Triangular Scale, No. 463 or 466,	70 00
The following set has beautifully finished Rosewood box, 15½ inches long by 10 inches wide, with lock and key and tray, and lined with finest silk velvet.	
265. Contains pair plain Dividers, No. 146. Pair Hair Spring Dividers, No. 149. Set of Instruments, No. 152. Proportional Dividers, No. 162. Steel Spacing Dividers, Nos. 167 and 168. Beam Compass, No. 172. Steel Bow Pen, No. 182. Set of Instruments, No. 158. Steel Bow Pencil, No. 186. Drawing Pens, Nos. 188, 189 and 190. Road Pen, No. 191. Dotting Pen with 6 wheels, No. 194. Protractor. Triangular Scale, No. 463 or 466. Set of Color Cups,	105 00

Finely Polished Rosewood or Black Walnut Cases, with German silver straps and corners, and lined with silk velvet, fitted up to order with such instruments as may be selected from Catalogue.

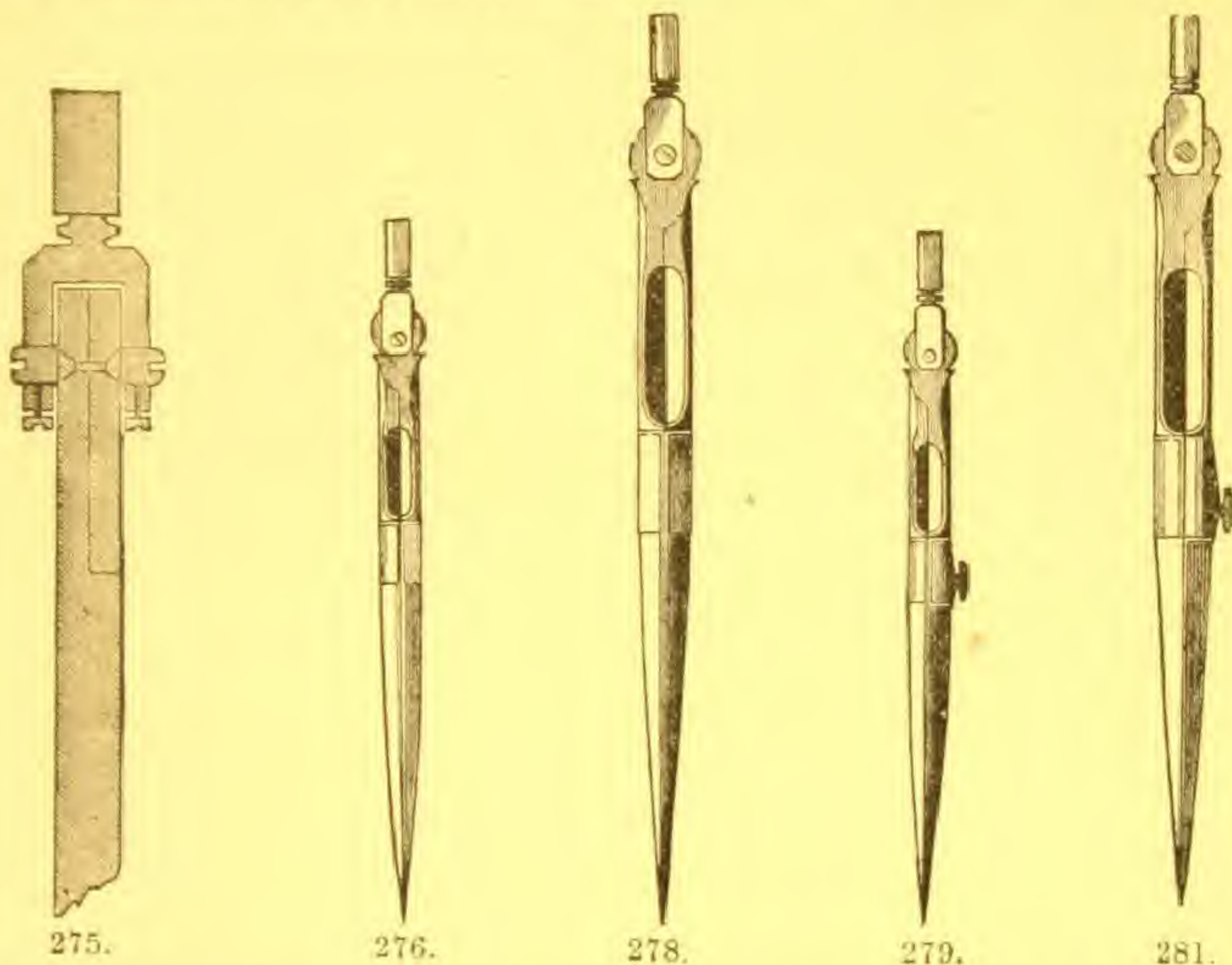
Extra Sets for Presentation a specialty.

CHAPTER IV.

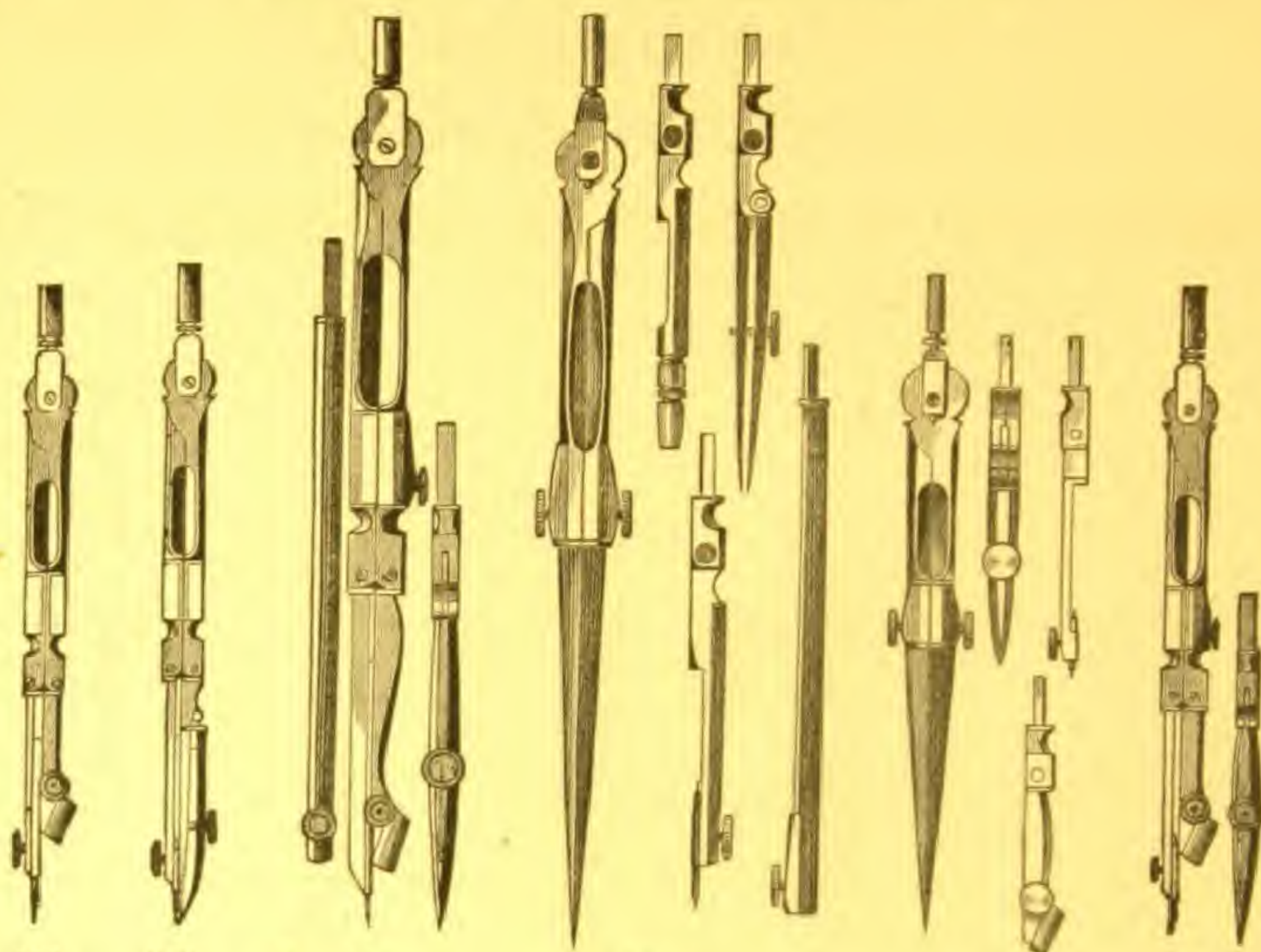
ALTENER'S PATENT JOINT DRAWING INSTRUMENTS.

The excellency of these instruments consists in the joints of the dividers being so constructed as to prevent any irregular motion when the legs are opened or closed, also for the general care with which the instruments are finished.

All the pens are thoroughly well made and pointed. No. 275 represents a sectional view of Altener's Patent Joint Divider Head.



No.		PRICE.
276.	Plain Dividers of German Silver, $3\frac{1}{2}$ inches long, with Altener's patent joint, each,	\$2.00
277.	Plain Dividers of German Silver, 5 inches long, with Altener's patent joint, each,	2.75
278.	Plain Dividers of German Silver, 6 inches long, with Altener's patent joint, each,	3.25
279.	Hair Spring Dividers of German Silver, $3\frac{1}{2}$ inches long, with Altener's patent joint, each,	3.00
280.	Hair Spring Dividers of German Silver, 5 inches long, with Altener's patent joint, each,	3.50
281.	Hair Spring Dividers of German Silver, 6 inches long, with Altener's patent joint, each,	4.00
282.	Needle Point Dividers, $3\frac{1}{2}$ inches long, of German Silver, with Pencil Point and Altener's patent joint, each,	4.25
283.	Needle Point Dividers, $3\frac{1}{2}$ inches long, of German Silver, with pen Point and Altener's patent joint, each,	4.75
284.	Needle Point Dividers, 6 inches long, of German Silver, with Pen and Pencil Point and Lengthening Bar, and Altener's patent joint,	7.50
284 A.	Dividers, $6\frac{1}{2}$ inches long, with Pen, Pencil, Needle Points, and Lengthening Bar,	8.50
284 B.	Same as 284 A, but with joint in each leg of Divider, as in No. 152,	11.00
284 C.	Dividers, $3\frac{1}{2}$ inches long, with Pen, Pencil, and Needle Point,	7.00
284 $\frac{1}{2}$.	Needle Point Dividers, $3\frac{1}{2}$ inches long, of German Silver, with Pen and Pencil Point, and Altener's patent joint,	6.25



282.

283.

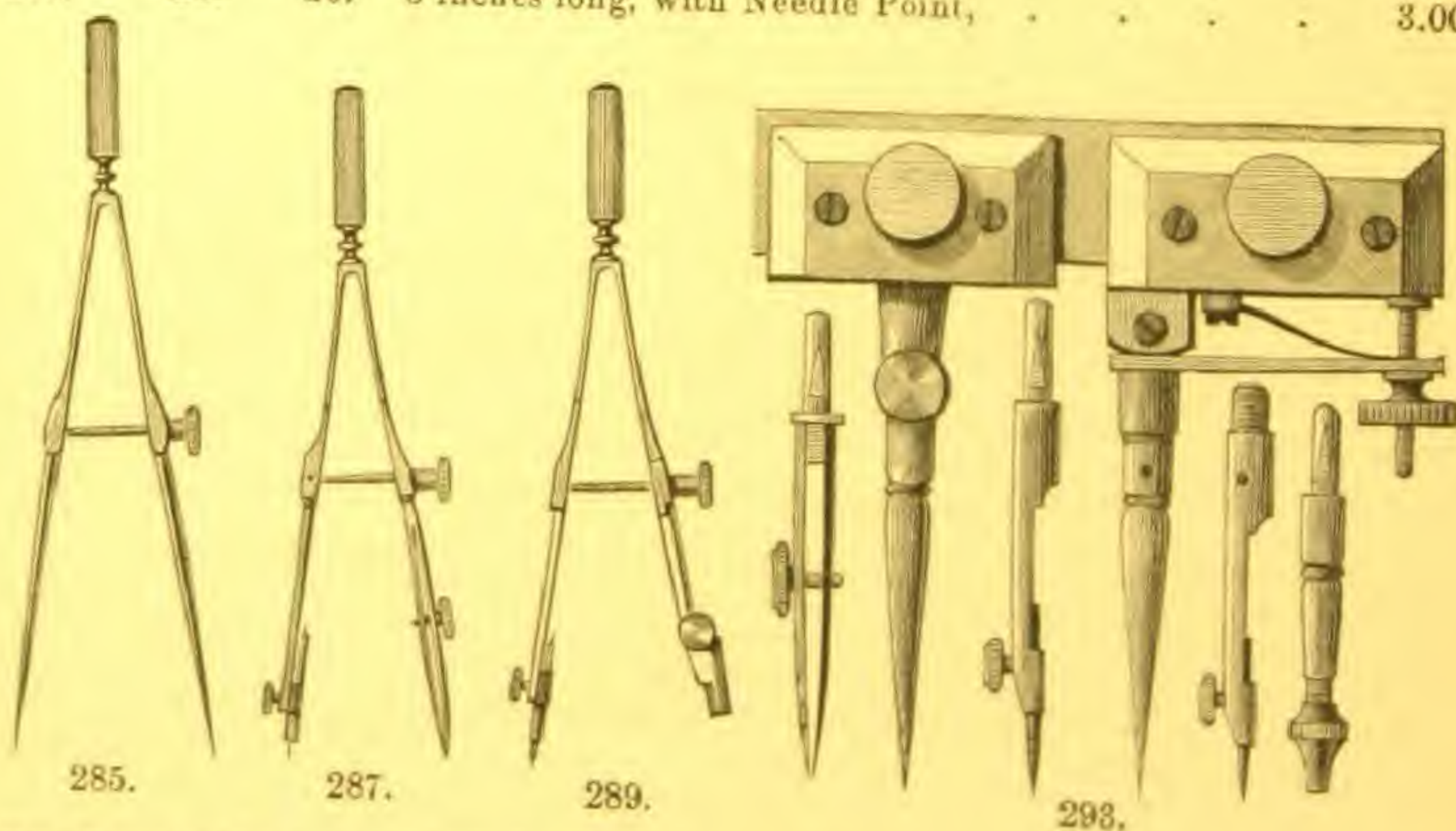
284.

284 A.

284 C.

284 1/2.

No.		PRICE.
285.	Steel Spacing Dividers, 3 inches long,	\$2.00
286.	Steel Bow Pen, 3 inches long, round points,	2.25
287.	Do. do. 3 inches long, with Needle Point,	3.00
288.	Steel Bow Pencil, 3 inches long, with round point,	2.25
289.	Do. do. 3 inches long, with Needle Point,	3.00



285.

287.

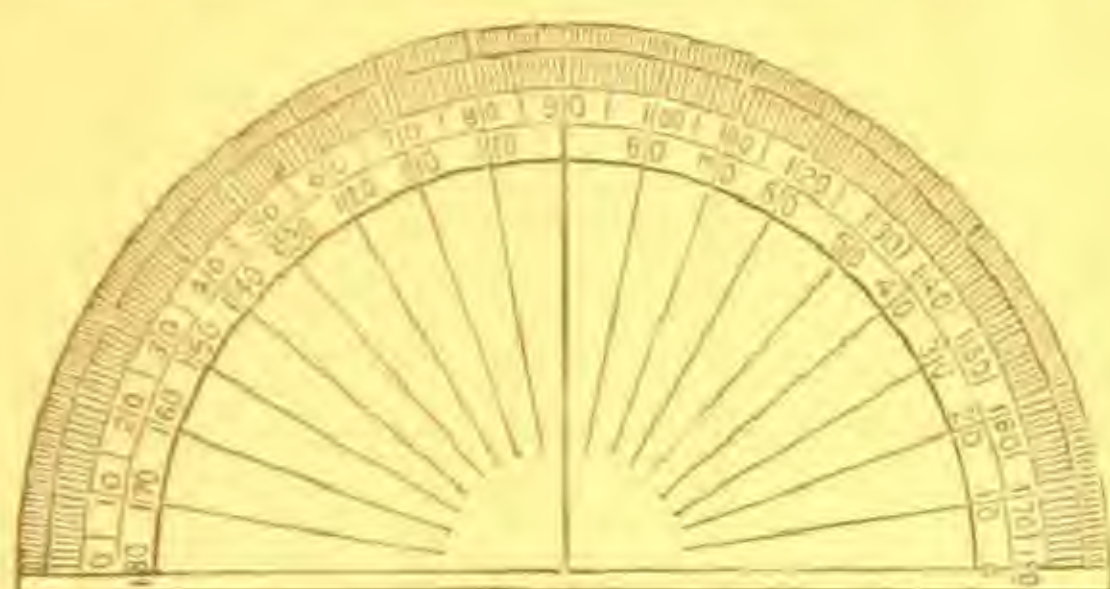
289.

293.

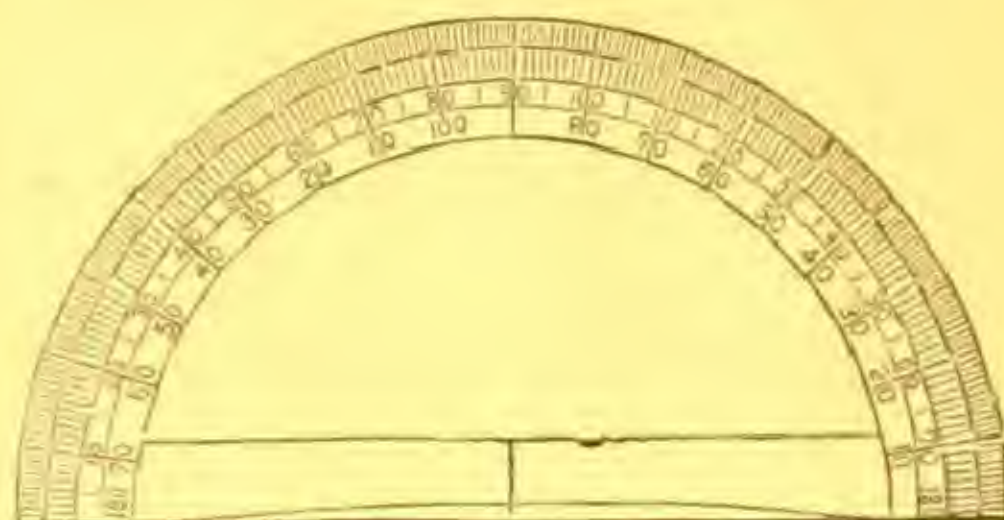
290.	Drawing Pens, 4 1/2 inches long,	
291.	Do. 5 1/2 do.	1.60
292.	Do. 6 1/2 do.	1.70
293.	Furniture for Straight-Edge Beam Compasses, with Spring Adjustment, in morocco box,	1.95
294.	Mahogany Bar, 30 inches long, for do.	8.75
295.	Boxwood Bar, 24 inches long, graduated, . . . . .	.75
		1.50

CHAPTER V.

PROTRACTORS OF HORN, BRASS, AND GERMAN SILVER.



301.



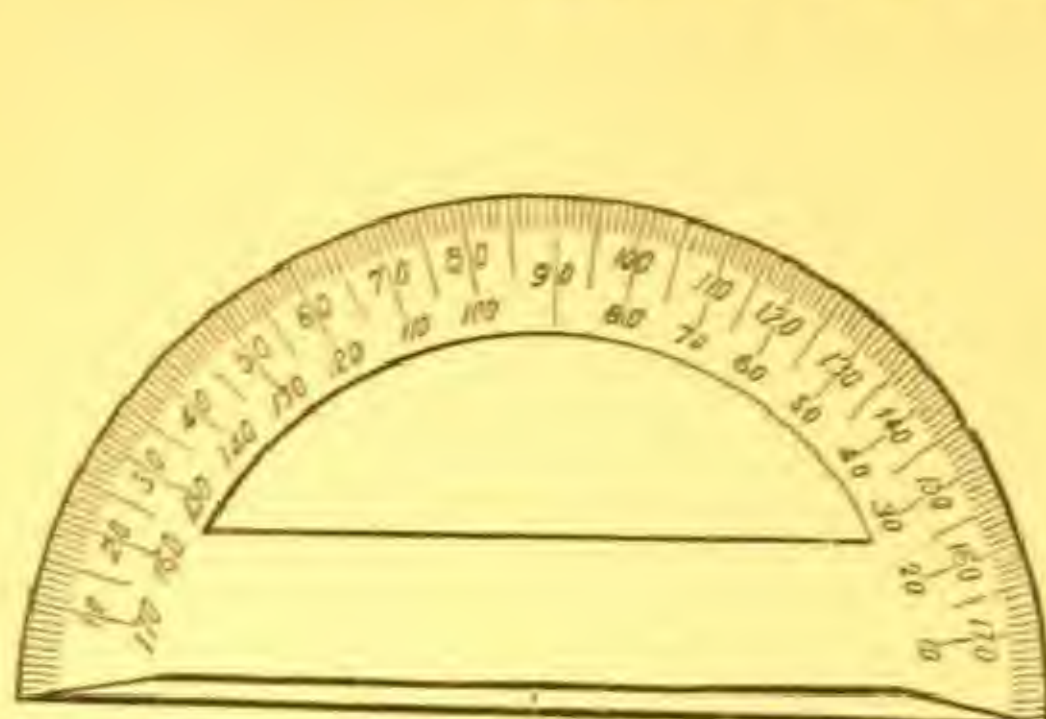
307.

No.							PRICE.
297.	Railroad Curve Protractor, of horn, 8 inches diameter, having laid off on it twenty-three curves from $\frac{1}{2}$ degree to 8 degrees, with a radius of 400 feet to the inch,						\$ 1.60
298.	Horn Protractors, 5 inches diameter, whole circle, half degrees,						1.00
299.	Do.	6	do.	do.	do.	. . . . .	1.25
300.	Do.	7	do.	do.	do.	. . . . .	1.50
301.	Horn Protractor, 4 inches diameter, half circle, whole degrees, . . . . .						.15
302.	Do.	5	do.	do.	half degrees, . . . . .		.25
303.	Do.	6	do.	do.	do. . . . .		.30
304.	Do.	7	do.	do.	do. . . . .		.50
305.	Do.	8	do.	do.	do. . . . .		.80
306.	Brass Protractor, 4 do. whole degrees, . . . . .						.10
307.	Do.	4	do.	do.	half degrees, . . . . .		.35
308.	Do.	5	do.	do.	do. . . . .		.55
309.	Do.	6	do.	do.	do. . . . .		.65
310.	German Silver Protractor, 4 inches diameter, half circle, whole degrees, . . . . .						.50
311.	Do.	do.	5	do.	do. half degrees, . . . . .		.85
312.	Do.	do.	6	do.	do. do.		1.00
313.	Do.	do.	7	do.	do. do.		1.15
314.	Do.	do.	5	do.	do. bev. edge, half deg.		1.25
315.	Do.	do.	6	do.	do. do. do.		2.00
316.	Do.	do.	7	do.	do. do. do.		2.65

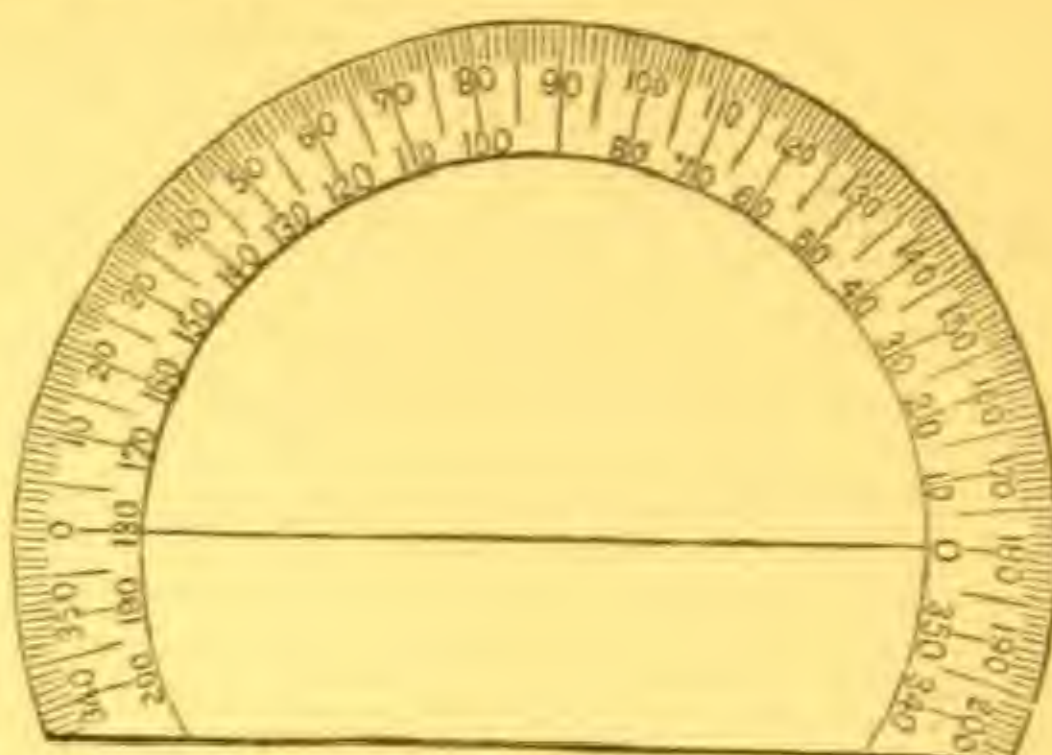
PAPER PROTRACTORS.

320.	Whole Circle Protractors, 8 or 13 inches diameter, half degrees, on drawing paper, printed in red or black, each, . . . . .						.30
321.	Same as No. 320, on Bristol boards, each, . . . . .						.40
322.	Same as No. 320, on vegetable tracing paper, . . . . .						.25
323.	Half Circle Protractor, 5 inches diameter, half degrees, on Bristol boards, each, . . . . .						.25

EXTRA FINE SWISS PROTRACTORS.



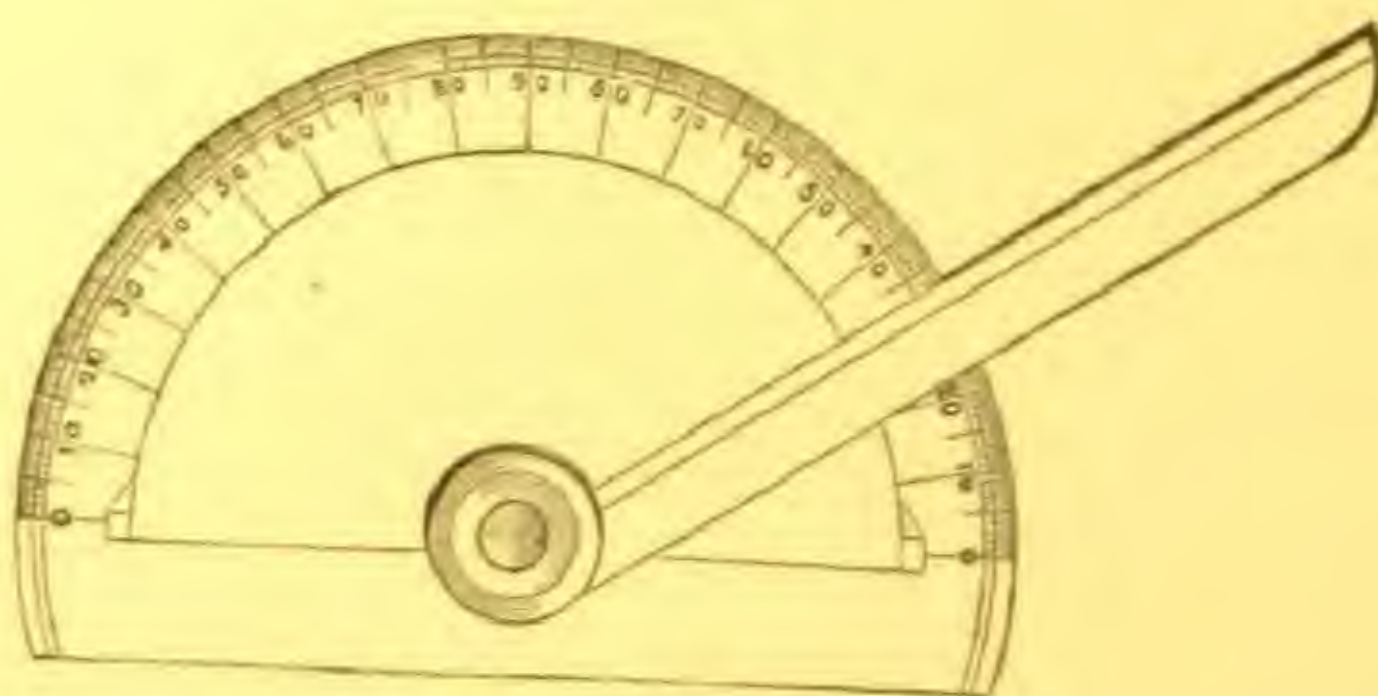
330.



334.

330.	Protractor, 4 inches diameter,	1	circle, whole degrees, centre on outer edge,	1	90
331.	Do. 5	do.	do.	do.	2 50
332.	Do. 6	do.	do.	do.	3 20
333.	Do. 6	do.	do.	do.	3 90
334.	Do. 5	do.	do.	do.	3 00
335.	Do. 6	do.	do.	inner edge,	3 50
336.	Do. 6	do.	do.	do.	4 60

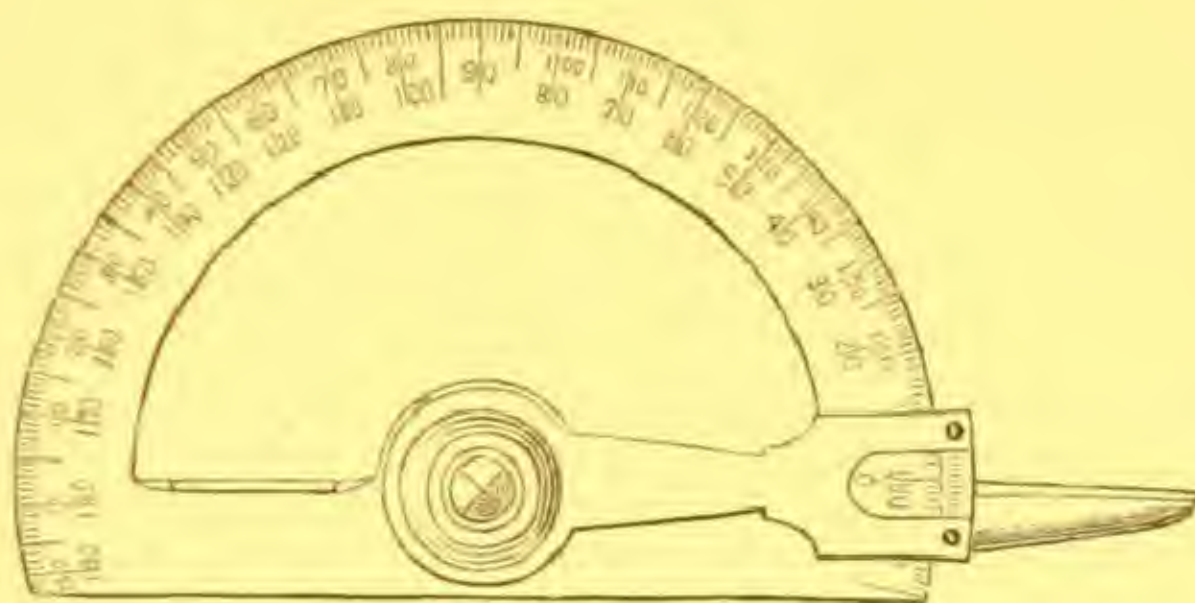
EXTRA FINE SWISS PROTRACTORS OF GERMAN SILVER, WITH ARMS.



350.

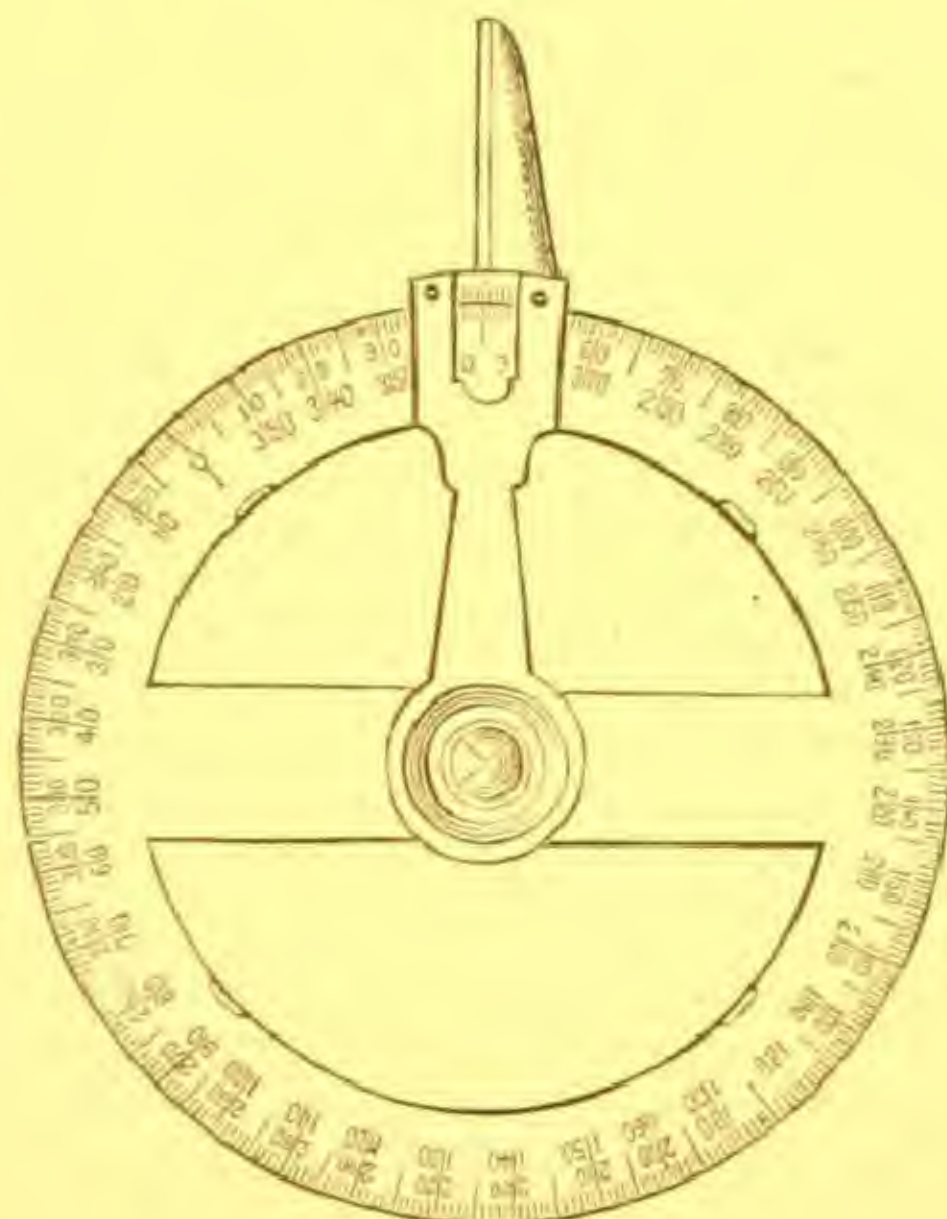
No.		Price.
350.	German Silver Protractor, 5 inches diameter, half circle, with Arm and divided in half degrees,	\$6.50
351.	German Silver Protractor, 6 inches diameter, half circle, with Arm and divided in half degrees,	7.50
352.	German Silver Protractor, 7 inches diameter, half circle, with Arm and divided in half degrees,	9.00
354.	German Silver Protractor, 8 inches diameter, half circle, with Arm and divided in half degrees,	12 00
360.	German Silver Protractor, 5 inches diameter, whole circle, with Arm and divided in half degrees,	10 00
361.	German Silver Protractor, 6 inches diameter, whole circle, with Arm and divided in half degrees,	12 00
362.	German Silver Protractor, 7 inches diameter, whole circle, with Arm and divided in half degrees,	14 00
363.	German Silver Protractor, 8 inches diameter, whole circle, with Arm and divided in half degrees,	16 00

EXTRA FINE SWISS PROTRACTORS OF GERMAN SILVER, WITH
ARMS AND VERNIERS.



370.

No.		PRICE.
370.	Protractor, $5\frac{1}{2}$ inches diameter, half circle, half degrees, with vernier reading to three minutes,	\$11 00
371.	Protractor, 8 inches diameter, half circle, quarter degrees, with vernier reading to one minute,	14 50
372.	Protractor, 10 inches diameter, half circle, quarter degrees, with vernier reading to one minute,	18 00



373.

373	Protractor, $5\frac{1}{2}$ inches diameter, whole circle, half degrees, with vernier reading to three minutes,	14 50
374.	Protractor, 8 inches diameter, whole circle, quarter degrees, with vernier reading to one minute,	16 25
375.	Protractor, 10 inches diameter, whole circle, quarter degrees, with vernier reading to one minute,	20 00

CHAPTER VI.

SECTORS, SCALES, AND PROTRACTORS.

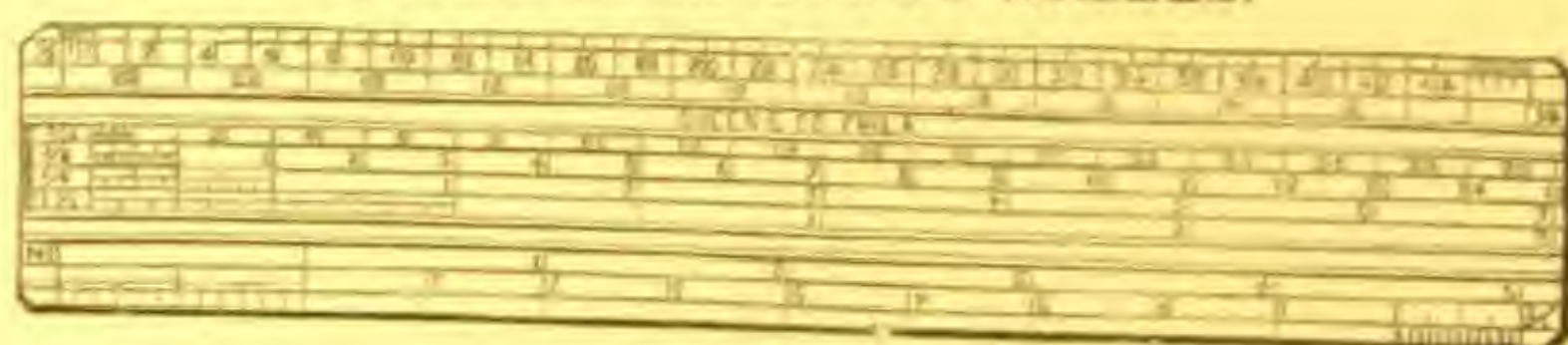


No.			Price.
400.	Ivory Sector, 6 inches long, opens to 12 inches long,		\$2 25
401.	Ivory Scale, 6 inches long, for school drawing,		75



402.	Ivory Chain Scales, 12 inches long, graduated on two edges with either 10 and 10 parts, or 10 and 20, or 20 and 40, or 30 and 50, or 40 and 60, or 50 and 60, each,	3 00
403.	Do. do. do. with 40 and 80, or 50 and 100, each,	5 25
404.	Do. do. do. with 80 and 100, each,	5 75
405.	Ivory Off Set Scales, 2 inches long, 10 by 10, 10 by 20, 20 by 40, 30 by 50, 40 by 60, each,	65

ARCHITECTS' IVORY SCALES.



406.	Ivory Scale, 12 inches long, with 16 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, 1 , $1\frac{1}{2}$, $1\frac{3}{4}$, 2 , $2\frac{1}{2}$, $2\frac{3}{4}$ and 3 inches to the foot, the first division of each scale subdivided in 12 parts, each,	3 00
407.	Same as No. 406, but with the first division of each scale subdivided into 10 parts, each,	3 00
408.	Ivory Scale, 12 inches long, with 12 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, 1 , $1\frac{1}{2}$, $1\frac{3}{4}$, 2 and 3 inches to the foot, the first division of each scale subdivided into 12 parts, diagonal scale reading to $\frac{1}{100}$ and $\frac{1}{1000}$ of an inch, each,	3 00
409.	Same as No. 408, but has the first division of each scale subdivided into 10 parts, each,	3 00



410.	Ivory Scale, 12 inches long, one side rounded the other flat, with the following scales, the graduations of which are all brought to the edge: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, 1 , $1\frac{1}{2}$, $1\frac{3}{4}$, 2 , $2\frac{1}{2}$ and 3 inches to the foot, the first division of each scale is subdivided into twelve parts, each,	3 00
411.	Same as No. 410, but the first division of each scale subdivided into ten parts, each,	3 00
412.	Flat Ivory Scale, 6 inch, div. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 inch to the foot, each,	2.00
413.	Do. do. 12 do. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 do. do.	3.25
414.	Do. do. 12 do. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 do. do.	3.25

IVORY PROTRACTORS.



425. FRONT SIDE.



425. REVERSE SIDE.

No.	PRICE.
425. Ivory Rectangular Protractor, 6 inches long, $1\frac{3}{4}$ inches wide, with scales as follows: front sides divided around edge from 0 to 180 degrees in single degrees, scales of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{8}$ and 1 inch to the foot, and scale of chords. Reverse side scales of 30, 35, 40, 45, 50 and 60 parts to the inch, scale of chords and diagonal scale of inches and $\frac{1}{100}$ ths,	\$1 75
426 Ivory Rectangular Protractor, 6 inches long by $1\frac{3}{4}$ inches wide, with scales as follows: front side, the edge divided in single degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ and 1 inch to the foot, and scale of chords. On the reverse side, scales of 30, 35, 40, 45, 50 and 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ ths,	2.25
427. Ivory Rectangular Protractor, 6 inches long by 2 inches wide, with scales as follows: front side, the edge divided in single degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$ inches to the foot, scale of chords, and line of 40 parts on lower edge. On the reverse side, scales of 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, diagonal scale of $\frac{1}{100}$ ths,	3 25
428. Ivory Rectangular Protractor, same as No. 427, but has the Protractor divided in $\frac{1}{2}$ degrees,	4 00
429. Ivory Rectangular Protractor, 6 inches long by $2\frac{1}{4}$ inches wide, with scales as follows: front side, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$ inches to the foot, scale of chords, and scale of 40 parts on lower edge. Reverse side, scales of 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, and diagonal scale of $\frac{1}{100}$ ths,	4 50
430. Ivory Rectangular Protractor, 6 inches long by $2\frac{1}{4}$ inches wide, with scales as follows: front side, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$ inches to the foot, scale of chords, and scale of 40 parts on lower edge. Reverse side, scales of 20, 25, 30, 35, 40, 45, 50 and 60 parts to the inch, 2 scales of chords, scales of latitudes, sines, tangents, hours, longitudes, secants, rhombs,	6 00
431. Ivory Rectangular Protractor, 8 inches long by 2 inches wide, with scales as follows: front side, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1 inch to the foot, scale of chords and scale of 40 parts on lower edge. Reverse side, scales of 30, 35, 40, 45, 50, 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ ths,	5 00
432. Ivory Rectangular Protractor, 12 inches long by $2\frac{1}{4}$ inches wide, with scales as follows: the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$, scale of chords and scale of 40 on lower edge. Reverse side, scales of 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ ths,	11 50

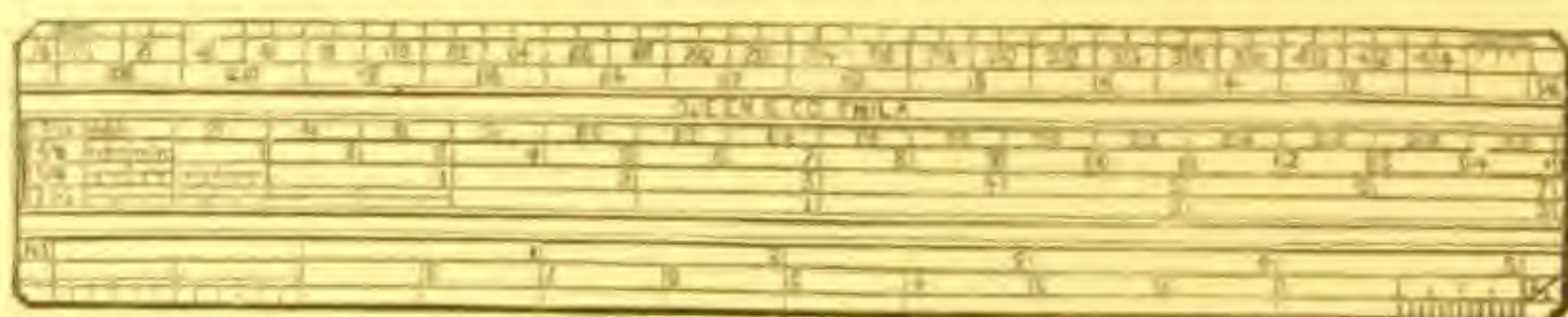
CHAPTER VII.

No.		PRICE.
450.	Boxwood Protractor, 6 inches long, $1\frac{3}{4}$ inches wide, whole degrees, with 6 scales of equal parts, 4 scales of feet and inches, 2 scales of chords, and diagonal scale,	\$0.50
451.	Boxwood Scale, 6 inches long, for School Cases of Instruments, . . . . .	.20



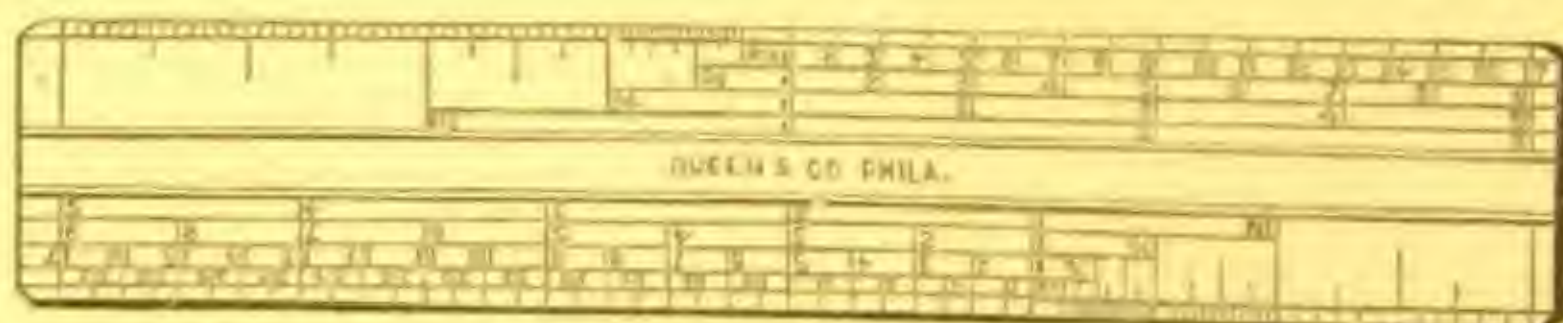
452.

452.	Boxwood Chain Scale, 12 inches long, graduated on two edges with either 10 and 10 parts, or with 10 and 20 parts, or with 20 and 40 parts, or with 30 and 50 parts, or with 40 and 60 parts, or with 50 and 60 parts,	1 25
453.	Boxwood Off-set Scales, 2 inches long, graduated 10 by 10, 10 by 20, 20 by 40, 30 by 50, 40 by 60, each,	25



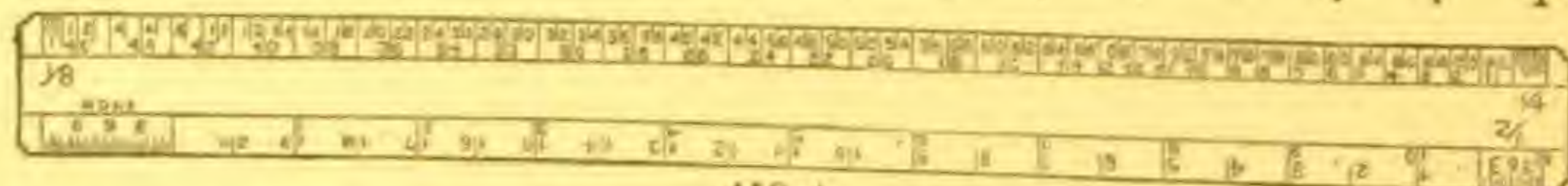
454.

454.	Boxwood Scale, 12 inches long, with 16 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2 , $2\frac{1}{4}$, $2\frac{1}{2}$ and 3 inches to the foot, the first division of each scale subdivided in 12 parts, each,	1 25
455.	Same as No. 454, but with the first division of each scale subdivided into ten parts, each,	1 25
456.	Boxwood Scale, 12 inches long, with 12 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2 and 3 inches to the foot, the first division of each scale subdivided into 12 parts, and diagonal scale reading to $\frac{1}{100}$ ths and $\frac{1}{200}$ ths of an inch, each,	1 25
457.	Same as No. 456, but has the first division of each scale subdivided into 10 parts, each,	1 25

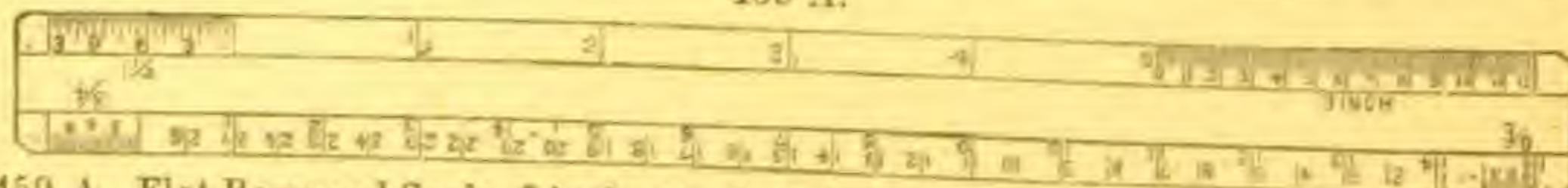


458.

458.	Boxwood Scale, 12 inches long, one side rounded, the other flat, with the following scales, the graduations of which are all brought to the edge: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2 , $2\frac{1}{4}$ and 3 inches to the foot, the first division of each scale subdivided into 12 parts, each,	1 25
459.	Same as No. 458, but has the first division of each scale subdivided into 10 parts, each,	1 25

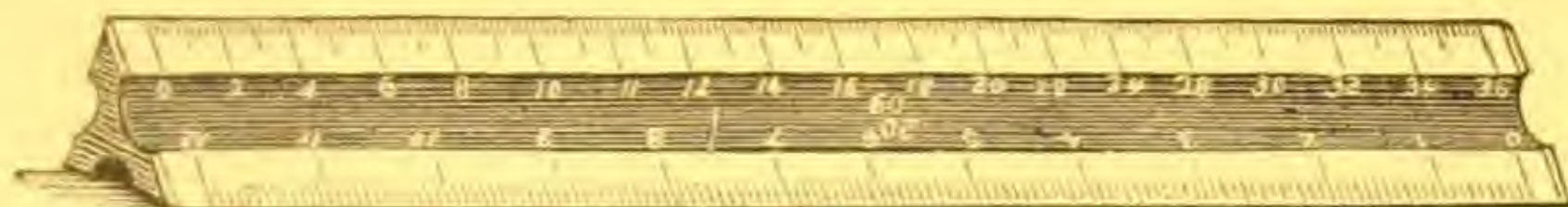


459 A.



459 A.	Flat Boxwood Scale, 6 inch, div. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 or $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 inch to foot, each	.80
459 B.	Do. do. 12 do. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 or $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 do. do.	1.25
459 C.	Do. do. 24 do. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 or $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 do. do.	2.00
459 D.	Flat Scale, 12 inch, bevelled on both sides, graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 and $\frac{3}{4}$, $1\frac{1}{2}$, 3 inch to the foot, each	1.75

No.		PRICE.
460.	Triangular Scale of German Silver, silver plated, 12 inches long, graduated, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 inch to the foot, each,	\$6.00
461.	Triangular Scale of German Silver, silver-plated, 12 inches long, graduated 10, 20, 30, 40, 50, and 60 to the inch, each,	6.00



462.

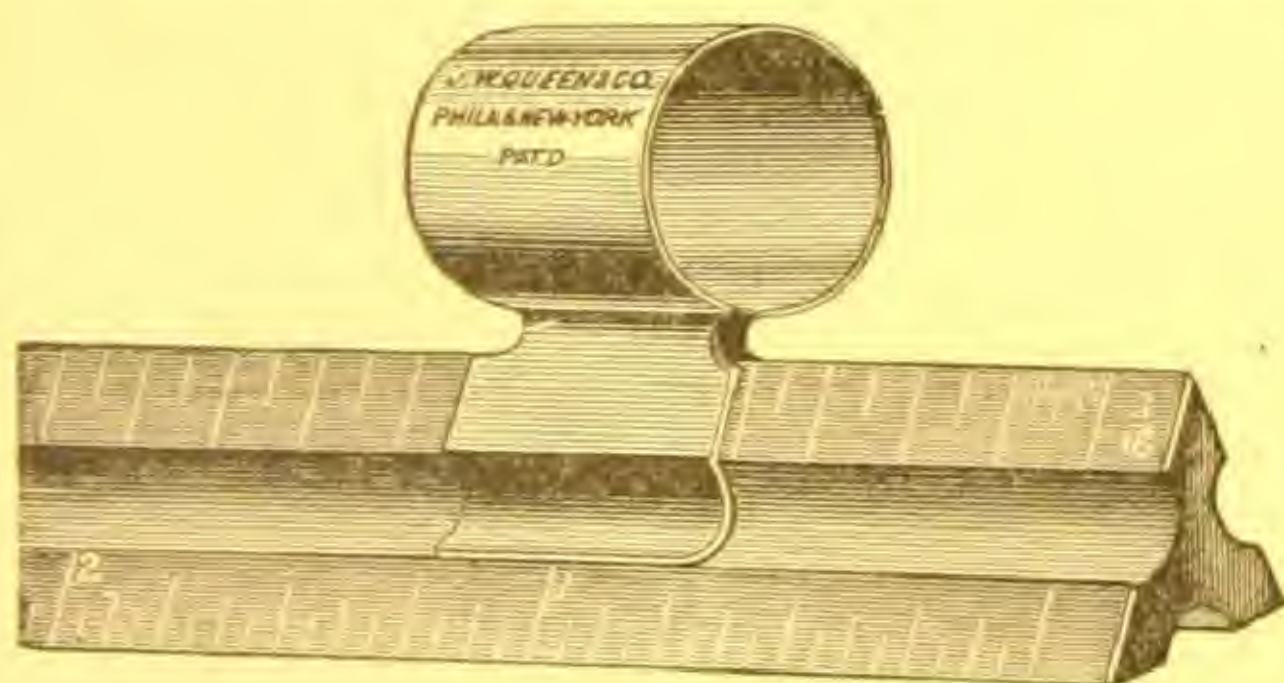
462.	Triangular Scale of Boxwood, 24 inches long, graduated 10, 20, 30, 40, 50 and 60 to the inch; or, 20, 30, 40, 50, 60 and 80, to the inch,	5 00
463.	Do. do. do. do. 12 inch,	2 00
463½.	Do. do. 12 inches long, graduated 100, 200, 300, 400, 500, 600 to the foot, each,	2 00
464.	Do. do. 6 inches, graduated same as No. 462,	1 50
464½.	Triangular Scales of Boxwood for Off-sets, 2 inches long, 10, 20, 30, 40, 50 and 60 parts,	75



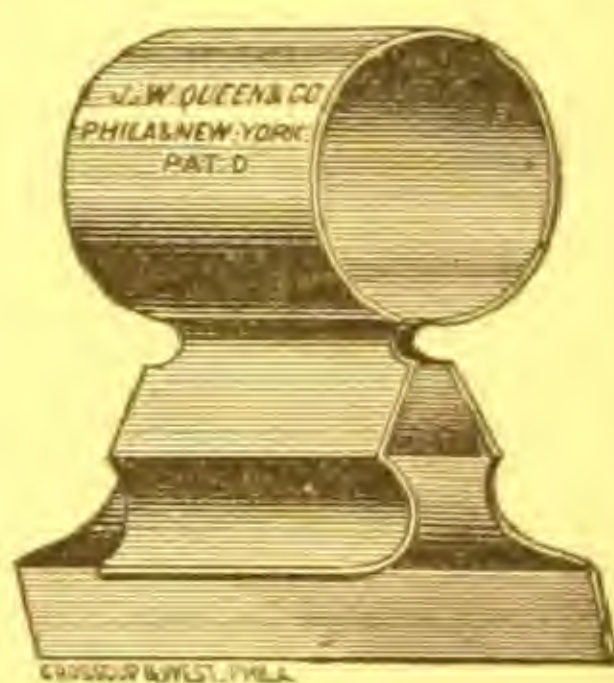
465.

465.	Triangular Scale of Boxwood, 24 inches long, graduated $\frac{3}{32}$, $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, 1½, 3 inches and 16ths to the foot,	5 00
466.	Do. do. do. 12 inches long,	2 00
467.	Do. do. do. 6 do.	1 50

Boxwood Triangular Scales, 6 and 12 inches put in strong paper boxes, and mailed to any address at an additional cost per scale of 25 cents.



470.



No.		PRICE.
470.	Triangular Scale Guard, each,	\$0.25
	A very useful attachment to the Triangular Scale, to obviate the liability to error, and the loss of time caused by the necessity of a careful examination of the scale each time it is used.	
471.	Gunter Scales, 12 inches, each, . . . . .	.75
472.	Do. 24 do.	1.25
473.	Boxwood School Rule, 12 inches, $\frac{1}{8}$ and $\frac{1}{16}$ inch, . . . . .	.15
474.	Do. do. do. $\frac{1}{8}$ bevelled brass edge, . . . . .	.35
475.	Do. do. 18 inches, do. do. . . . .	.50

PAPER SCALES.

480. Paper Scale, printed on card-paper, $1\frac{1}{2}$ inch wide, 12 inches long, graduations on one edge inches and 10ths, and the other feet and 100ths, 10
481. Paper Scale, same as 480, one edge 20 parts to the inch, the other edge 40, 10
482. Paper Scale, same as 481, one edge inches and sixteenths, the other edge inches and forty-eighths, 10
483. Paper Scales, printed on card-paper, 19 inches long, for architects and engineers, in sets of 6 scales, per set, 1 00
 Series A contains 6 scales, one each, divided to $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 3 inches to the foot.
 Series B contains 6 scales, one each, divided to $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{5}{16}$, $\frac{3}{8}$, and $\frac{7}{8}$ inch to the foot.
 Series C contains 6 scales, one each, divided to 10, 20, 30, 40, 50 and 60 parts to the inch.
484. Single Scale of any of the above series, A, B, C—each scale, 20
485. Paper Scales, same as 483, divided either to $\frac{1}{2}$, $1\frac{1}{8}$, $1\frac{1}{4}$ or $1\frac{3}{8}$ inches to the foot, each, 20

The advantages of these scales are—they expand and contract nearly the same as drawing-paper, do not soil the work, and distances can be set off from them without the use of dividers.

We manufacture to order scales to any divisions, in ivory, boxwood, whitewood, or rubber.

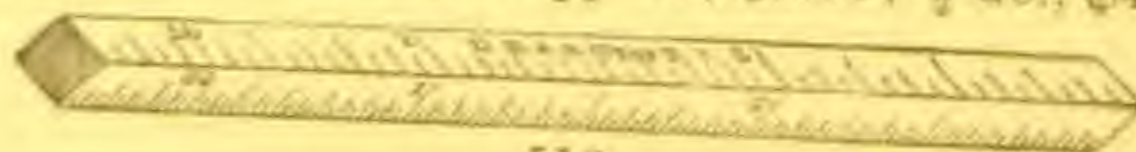
CHAPTER VIII.

SQUARES, CALIPERS FOR MACHINISTS, STRAIGHT EDGES.



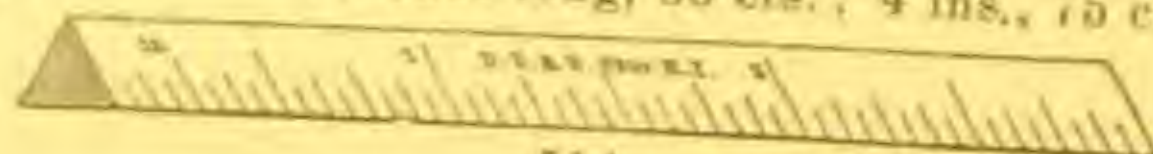
500.

500. 24 Inch Steel Rule, graduated to inches, 8ths, 10ths, 12ths, 16ths, 20ths, 24ths, 32ds, 48ths, 50ths, 64ths, and 100ths of an inch, 4.00
501. 12 inches, do. do. do. 2.00
502. 9 do. do. do. do. 1.50
503. 6 do. do. do. do. 1.00
504. 4 do. do. do. do. .75
505. 3 do. do. do. do. .50
506. Steel Rule and Scale, 12 inches long, divided in inches and 16ths on one side, and inches and 12ths or 10ths on the other, .75
507. Same as 506, but divided in inches and 16ths on one side, and inches, 8ths, 32ds, and 64ths on the other, 1.00
508. Same as 506, but divided in inches and 16ths on one side, and centimeters and millimeters on other side, 1.25
509. Steel Shrink Rule, $24\frac{1}{4}$ inches long, graduated as No. 500, 4.50
510. Boxwood Shrink Rule, $24\frac{1}{4}$ inches long, graduated as No. 500, 3.00
511. Steel Standard Yard Measure, graduated to inches and 8ths on one side, and on the other side to $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and $\frac{7}{8}$ of a yard, 3.00
512. Steel Standard French Measures, subdivided to centimeters and millimeters. $\frac{1}{2}$ meter long, \$1.75; $\frac{3}{4}$ do., \$2.50; $\frac{1}{2}$ do., \$4.00; 1 do., 10.00



513.

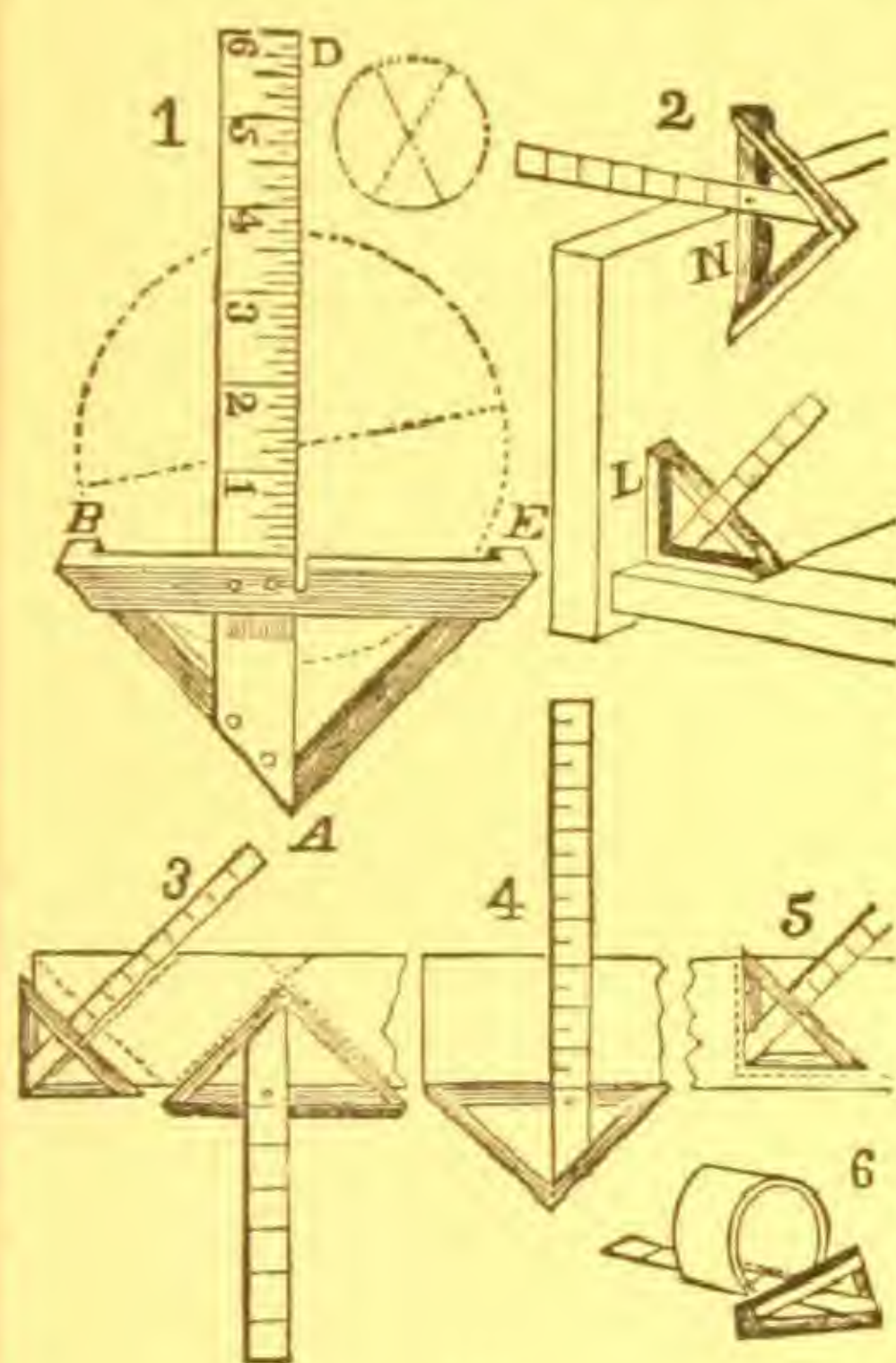
513. Square Steel Rules, divided to 8ths, 16ths, 32ds, 64ths, and 100 parts to the inch, 3 inches long, 50 cts.; 4 ins., 75 cts.; 6 ins., 1.00



514.

No.		PRICE.
514.	Triangular Steel Rules, 3 inches long, divided to 12, 16, 20, 24, 32, 48, 50, 64, and 100 parts to the inch,	\$0.60
	4 inch, 80 cts.; 6 inch, \$1.20; 12 inch,	3.00
514½.	Centre Gauge, and Gauge for Grinding and Setting Screw Tools,	.50
The angles used in this Gauge are 60 degrees. The four divisions upon the Gauge of 14, 20, 24, and 32 parts to the inch, are very useful in measuring the number of threads to the inch of taps and screws. The following parts to the inch can be determined by them, viz., 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, and 32.		
Any of the above Scales nickel-plated for five cents per running-inch.		

AMES' PATENT UNIVERSAL SQUARE.



This square combines, in a most convenient form, *five different instruments*, viz., The TRY-SQUARE, the MITER, the T-SQUARE, the GRADUATED RULE, and (what is entirely new) the CENTRE-SQUARE, for finding the centre of a circle.

Fig. 1 explains its application as a CENTRE-SQUARE. Put the instrument over the circle, as the end of the bolt or shaft, with the arms B A, A E resting against the circumference, in which position one edge of the rule, A D, will cross the centre. Mark a straight line in this position; apply the instrument again to another part of the circumference, and mark another line crossing the first. The point where the two lines cross each other will be the centre of the circle. The whole is the work of a moment. Fig. 2 explains the application of the instrument as a carpenter's TRY-SQUARE, N, and an OUTSIDE SQUARE, L; Fig. 3, as a MITER; Fig. 4, as a T-SQUARE and a GRADUATED RULE; Figs. 5 and 6 as an OUTSIDE SQUARE for drawing, and a T-SQUARE for machinists.

The tongue D A, (Fig. 1,) being fastened, as it is, into the triangular frame B A E, cannot be moved or knocked from its place,—in this respect constituting a great improvement over the carpenter's Try-Square, T-Square, and Miter in common use. The instruments are made of the best material, neatly finished, and perfectly true.

"As a CENTRE-SQUARE alone, it is invaluable to every mechanic. . . . In short, it combines, in a most convenient form, so many useful instruments, no mechanic's list of tools can well be complete without a Universal Square."—*Scientific American*, Sept. 22, 1855.

515.

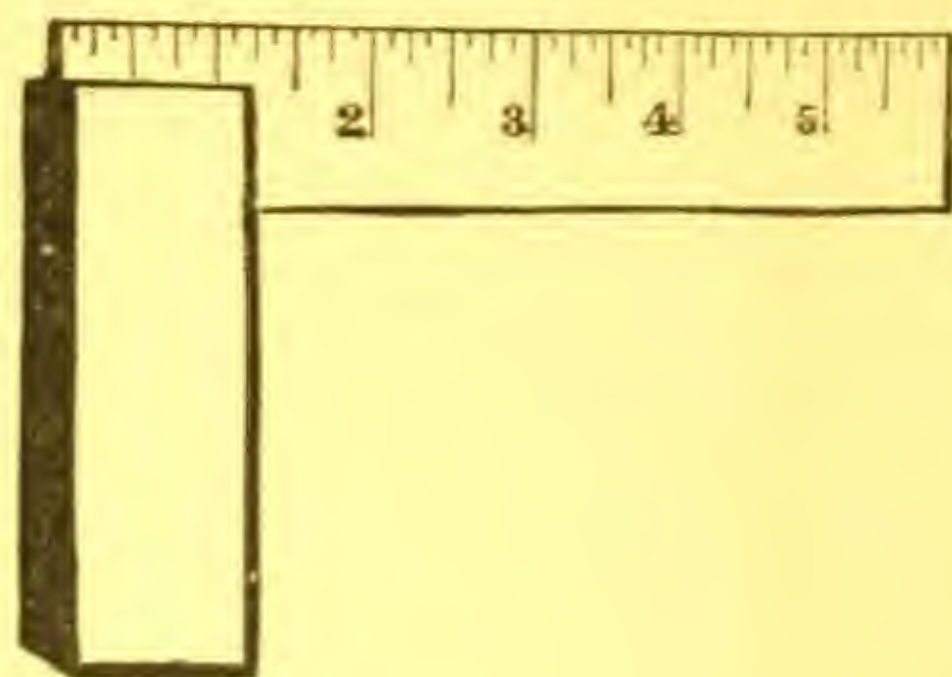
515.	Ames' Patent Universal Square, blade	6 inches long,	.	.	.	.	3 00
516.	Do.	do.	8	do.	.	.	4 00
517.	Do.	do.	10	do.	.	.	5 00
518.	Do.	do.	12	do.	.	.	6 00

WILLIS' ODONTOGRAPH.

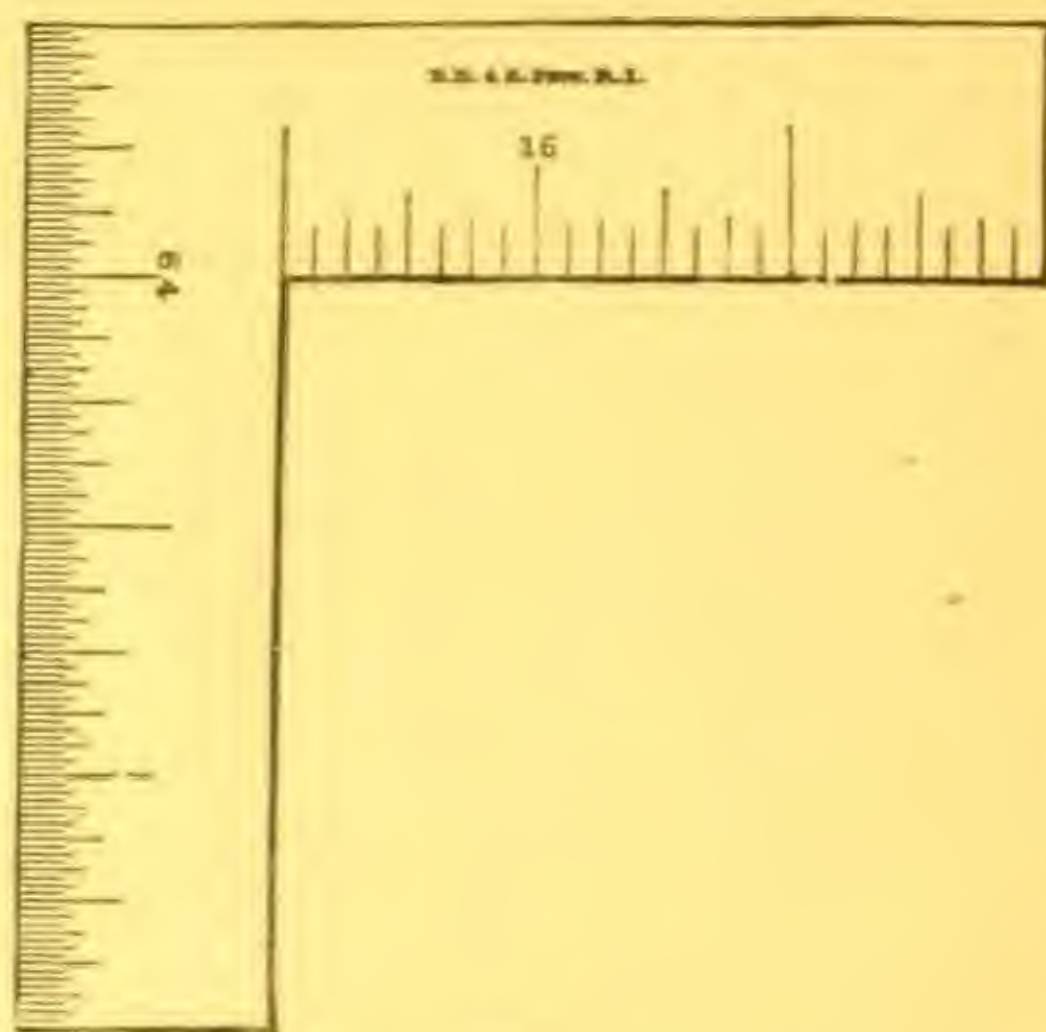
This is an instrument recently invented by Prof. R. Willis, of Cambridge University, England, for describing the correct form of the teeth of wheels, and the templets and cutters used in making them. All wheels of the same pitch, but of different sizes, having their teeth drawn with this instrument, will run together correctly.

519.	Willis' Odontograph, for drawing the teeth of small wheels by diametrical pitch, when only a single arc is required, with drawing and direction for use,	2 50
520.	Willis' Odontograph, for drawing the teeth of larger wheels by circular pitch, where it is necessary to have separate arcs for flanks and faces, with drawing and direction for use,	4 00

No.						PRICE.
521.	Heavy Headed Square, made of hardened steel, for machinists, graduated to inches and 32ds of an inch, blade 3 inches long, . . .					\$2.50
522.	Do.	do.	blade 4	do.	. . .	3.00
523.	Do.	do.	blade 6	do.	. . .	3.50
524.	Do.	do.	blade 9	do.	. . .	4.00
525.	Do.	do.	blade 12	do.	. . .	6.00



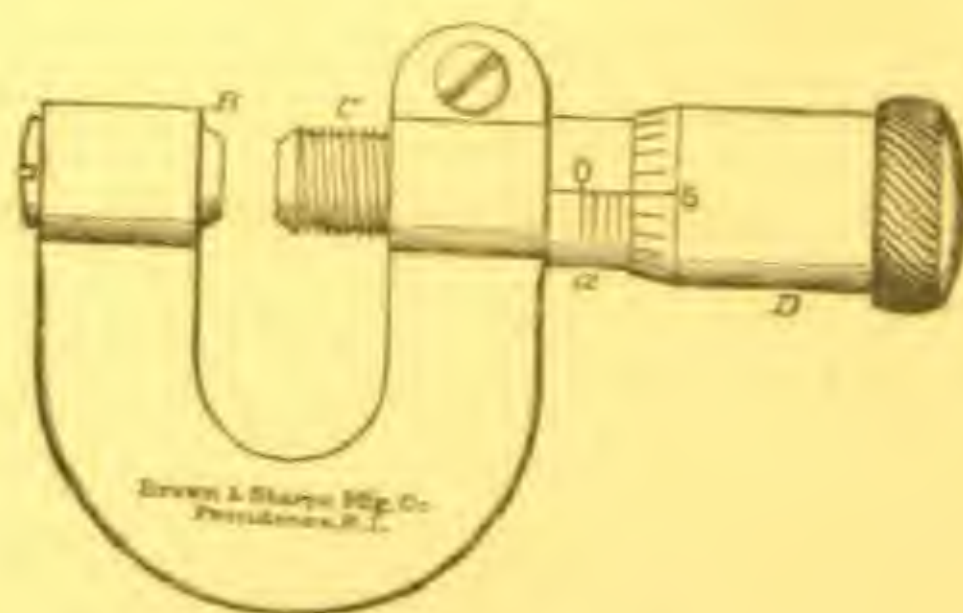
521.



526.

526. Light Squares, made of hardened steel, for machinists, graduated on one side to inches, 16ths and 64ths of an inch, and on the other side to inches, 32ds and 64ths of an inch, sides 2 inches long, . . . 1.50
527. Same as No. 526, sides 3 inches long, . . . 2.00
528. Same as No. 526, sides 4 inches long, graduated on both sides to inches, 16ths and 32ds of an inch, . . . 2.50
529. Same as No. 527, sides 6 inches long, . . . 3.50

Any of the above Squares nickel-plated for five cents per inch of blade.

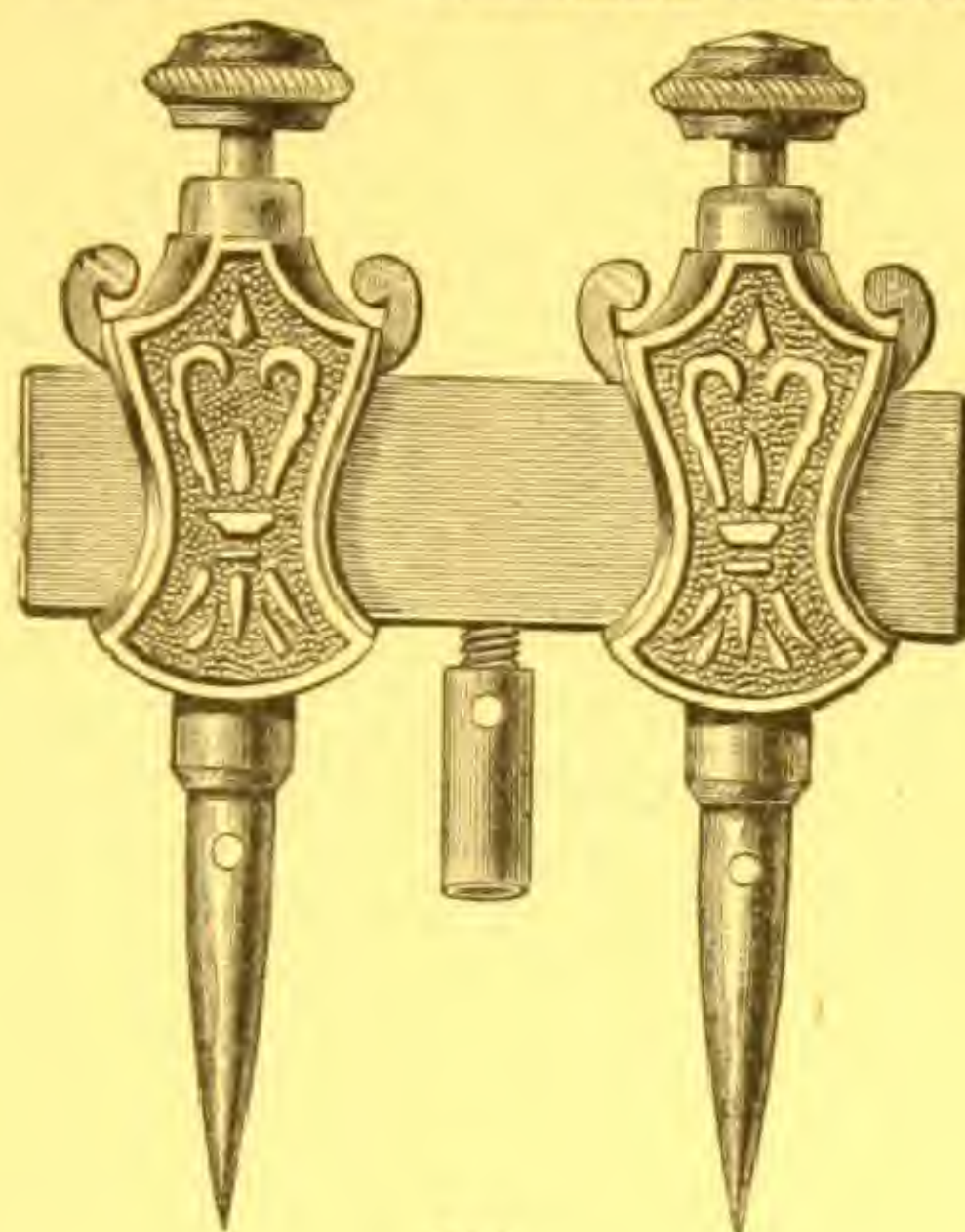


530. (Full size.)

530. Pocket Sheet-Metal Gauge, nickel-plated, in morocco case, . . . 6.75

These Gauges will measure the thickness of sheet-metal, or other material, by thousandths of an inch up to three-tenths of an inch at any point within half an inch of the edge, and can be applied as easily as the common gauge. It will also answer to measure the diameter of wire. Means of adjustment are provided in case of wear by continued use.

IMPROVED TRAMMEL POINTS.

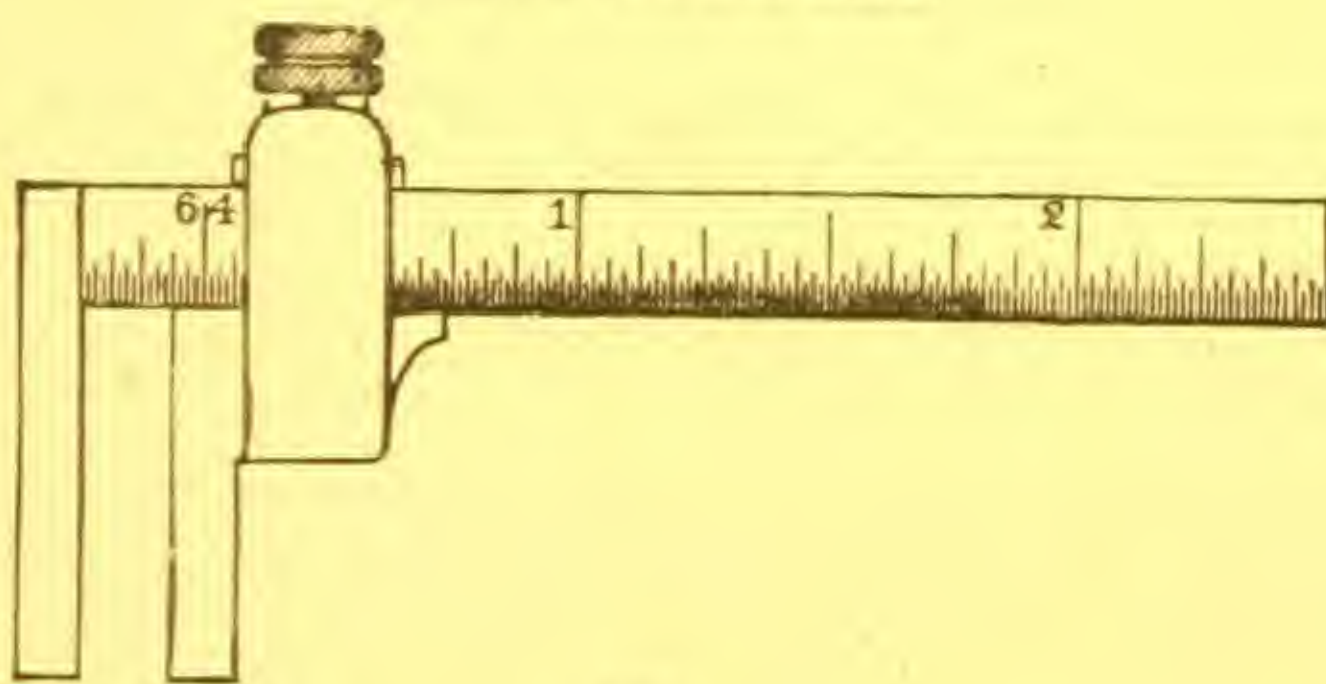


532.

These tools are used by all machinists and mechanics who have occasion to strike arcs, or circles, larger than can be done by compass Dividers. They may be used on a straight wooden bar of any length, and when secured in position by the thumb-screws, all circular work can be readily laid out. They are made of bronze, and have steel points, either of which can be renewed, and replaced by pencil socket, which accompanies each pair.

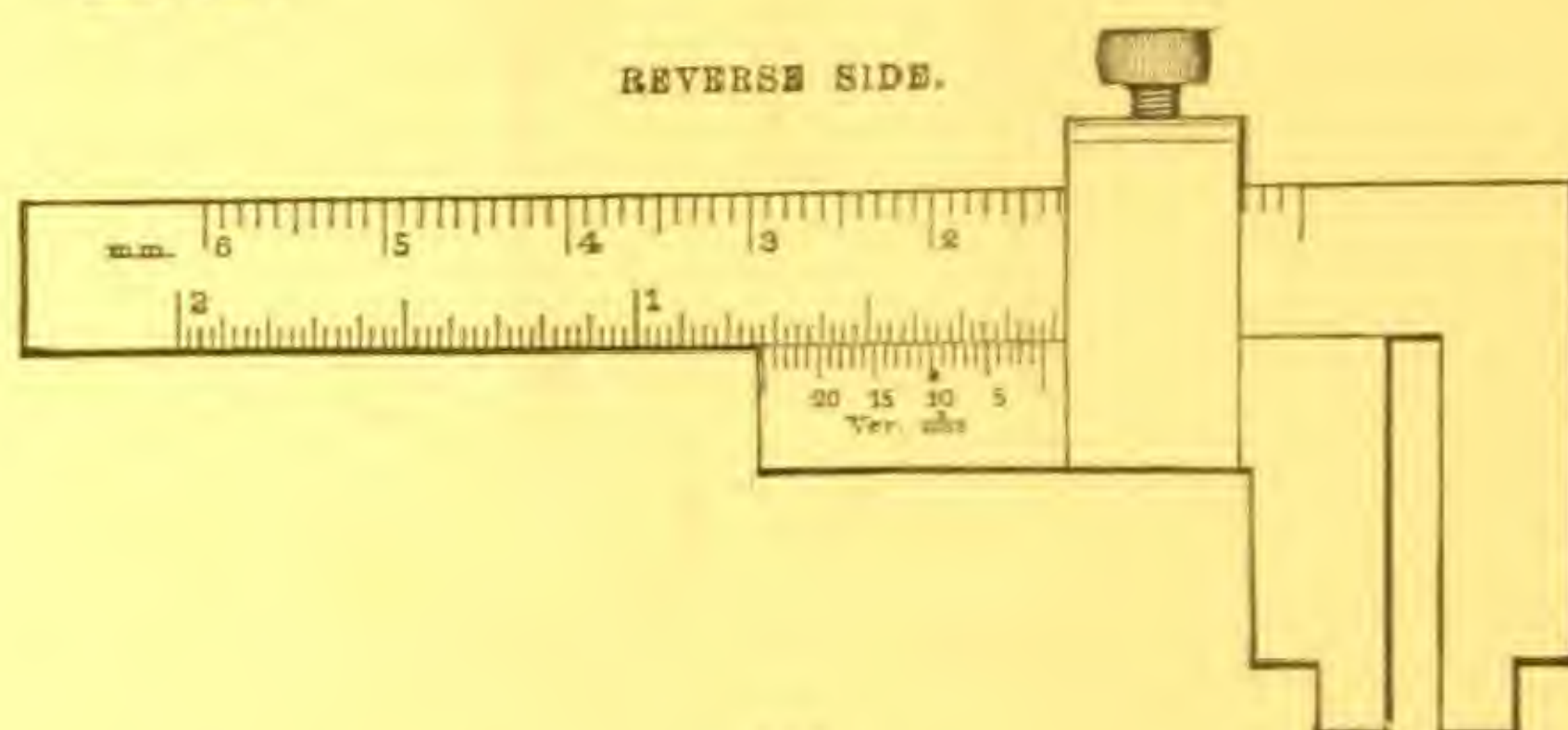
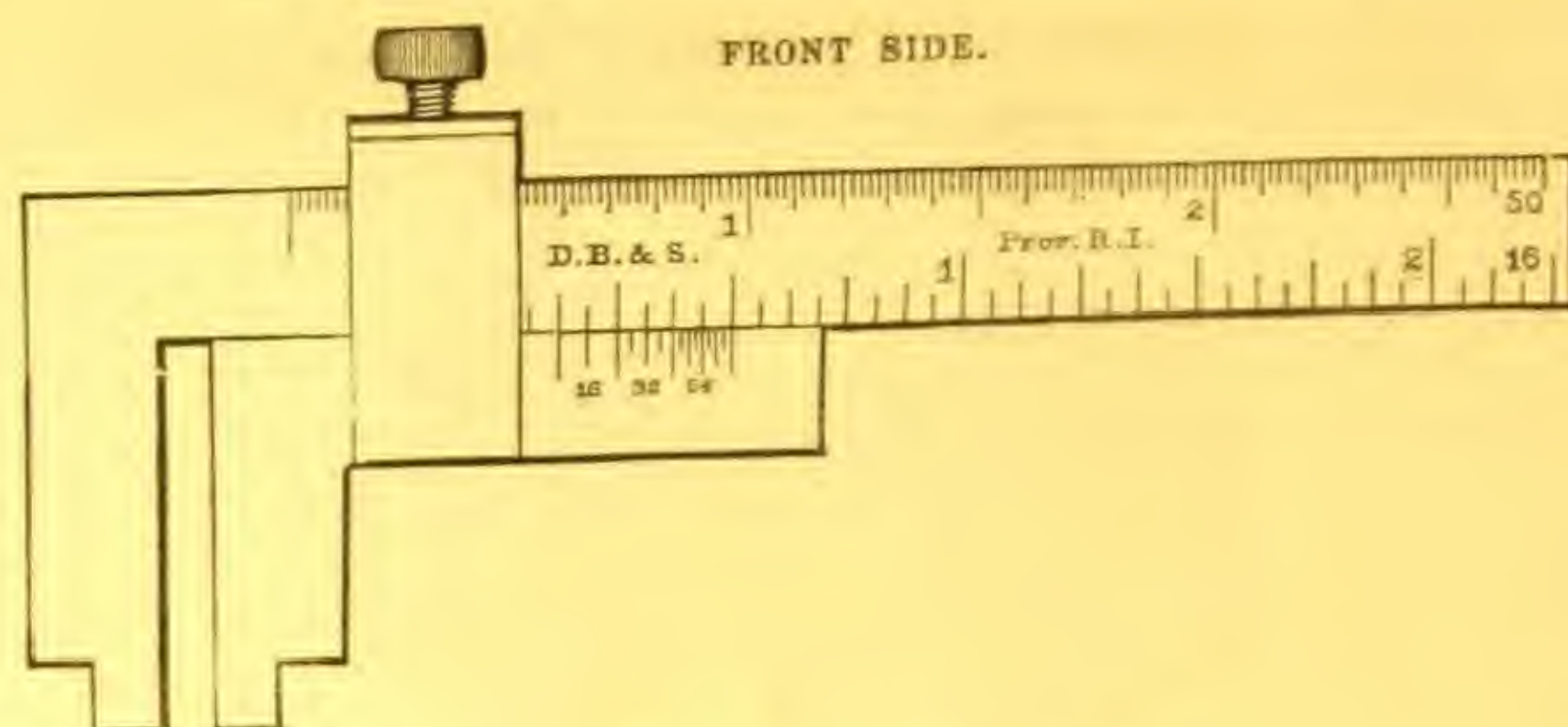
No.		PRICE.
531.	Small (No. 1), per pair,	\$1.50
532.	Medium (No. 2), per pair,	2.00
533.	Large (No. 3), per pair,	2.75

STEEL CALIPERS.



535.

535.	Plain Steel Caliper, 2 inches long, graduated to 64ths of an inch, . . .	3.50
536.	Do. do. 3 inches long, divided to 64ths of an inch, . . .	4.50
537.	Verniered Steel Calipers, 2½ inches long, the lower edge of front side graduated to inches and 16ths of an inch, and reading by the vernier to 32ds and 64ths of an inch; and the upper edge of same side graduated to inches and 50ths of an inch. The lower edge of the reverse side graduated to inches and 40ths of an inch, and reading by the vernier to 1000ths of an inch. The upper edge of same side graduated to centimeters and millimeters,	5.00



537.

No.							PRICE.
538.	Same as No. 537, but in morocco case,	.	.	.	.	.	\$6.00
539.	Pearwood Ovals, 2 to 6 inches long, 10 in a set, per set,	.	.	.	.	.	2.00
540.	Do. $1\frac{1}{2}$ to $4\frac{1}{2}$ do. 6 do. do.	.	.	.	.	.	1.50
541.	Do. $\frac{3}{4}$ to 7 do. 43 do. do.	.	.	.	.	.	5.00
542.	Pearwood Hyperbolas, 2 to 5 inches long, 8 in a set,	.	.	.	.	.	1.40
543.	Do. Parabolas, 12 do.	.	.	.	.	.	3.00
544.	Do. do. $1\frac{1}{2}$ to 6 inches long, 8 do.	.	.	.	.	.	1.40



545.

545.	Whitewood, bevelled edge, thick,					
	12	18	24	30	36	42 inch.
	each, \$.15	.20	.25	.30	.40	.50.



546.

546.	Hardwood lined, square edges, thin:					
	24	30	36	42	48	54 inch.
	each, \$.40	.50	.70	.85	1.15	1.50



547.

547.	Mahogany, Ebony lined, square edges, thin:					
	24	30	36	42	48	54 inch.
	each, \$.55	.70	1.00	1.25	1.60	2.00.



548.

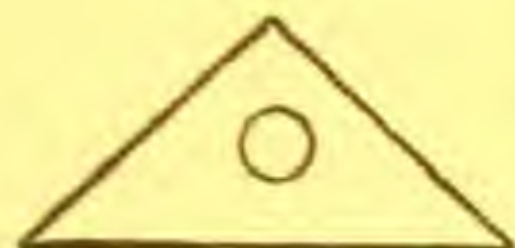
No.
548. Hard Rubber Rules.

PRICE.

	12	18	24	30	36	42 inch.		
each, \$	.50	.70	1.00	1.50	2.00	2.50.	
549. Steel, with one edge bevelled the other square,								
	18	24	30	36	48	60	72 inches long.	
each, \$	1.50	2.75	3.50	4.50	6.00	9.00	11.50.	
550. Steel, one edge bevelled the other square, nickel plated,								
	18	24	30	36	42	48	60	72 inches long.
each \$	1.75	3.00	4.00	5.00	6.00	8.00	10.50	14.00.



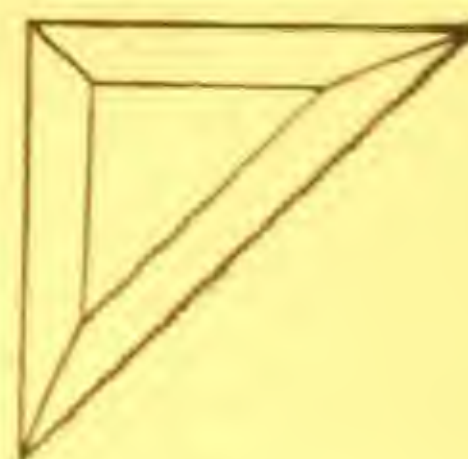
560.



561.



562.



563.

560. Pearwood Triangles, $30^\circ \times 60^\circ \times 30^\circ$
 5 or $6\frac{1}{2}$ 8 or $9\frac{1}{2}$
 10 cents. 15 cents.

11 or 12 inches long.
 20 cents.

561. Pearwood Triangles, $45^\circ \times 45^\circ \times 90^\circ$
 4, 5, or 6 inch,
 15 cents.

7 or 8 inches long.
 20 cents.

562. Pearwood or Cherry Triangles, framed open centre, $30^\circ \times 60^\circ \times 90^\circ$
 6 8 $9\frac{1}{2}$ 11 13 15 20 inches long.
 \$.20 .25 .25 .30 .40 .75 1.00.

563. Pearwood or Cherry Triangles, framed open centre, $45^\circ \times 45^\circ \times 90^\circ$
 5 $6\frac{1}{2}$ 8 10 12 14 inches long
 \$.20 .25 .30 .40 .60 .75.



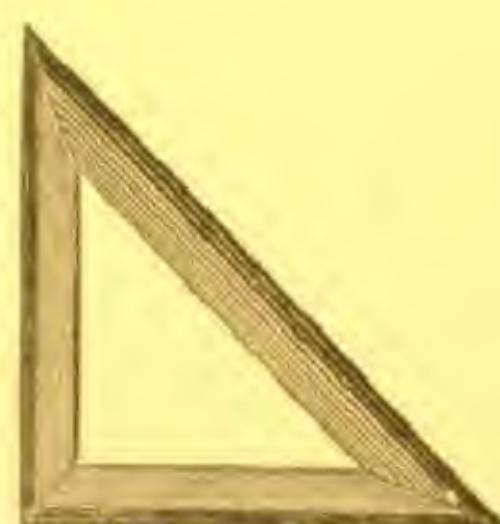
564.



565.



564.



565.

564. Mahogany or Walnut Triangles, ebony or maple lined, framed open
 centre, $30^\circ \times 60^\circ \times 90^\circ$
 5 6 7 9 11 13 15 18 inches long.
 \$.50 .60 .70 .80 1.00 1.25 1.75.

565. Mahogany or Walnut Triangles, ebony or maple lined, framed open
 centre, $45^\circ \times 45^\circ \times 90^\circ$
 5 6 $7\frac{1}{2}$ 9 11 13 15 inches long.
 \$.50 .60 .70 .80 1.00 1.25 1.75.

600. Hard Rubber Triangles, angles 30, 60, and 90 degrees.

Perpendiculars, 4 5 6 7 8 9 10 11 12 13 14 15 16 17 ins.
\$.25 .30 .35 .40 .55 .60 .65 .75 .95 1.10 1.25 1.50 1.75 1.90 each.



600.



603.



609.

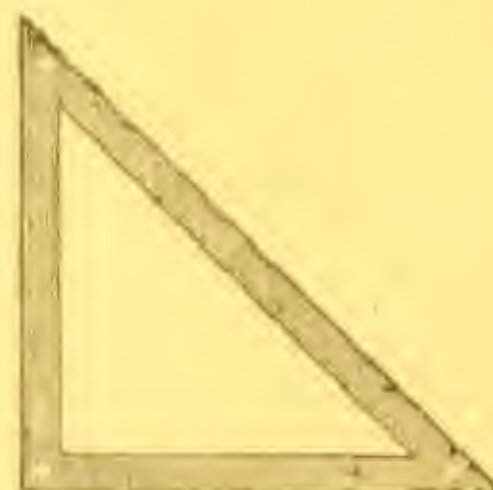
603. Hard Rubber Triangles, angles 45, 45 and 90 degrees.

Isosceles Sides, 3 4 5 6 7 8 9 10 11 12 13 14 ins.
\$.30 .35 .40 .50 .60 .70 .85 1.10 1.25 1.35 1.50 1.65 each.

609. Hard Rubber Lettering Triangles, 3 in set, $3\frac{1}{2}$ inch, per set, 1.25
single templets, .50



610.



619.

- | | |
|--|------|
| 610. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 6 inches long, each, | 2 50 |
| 611. German Silver Triangles, angles 30, 60 and 90 degrees, perpendicular 7 inches long, each, | 2 75 |
| 612. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 8 inches long, each, | 3 00 |
| 613. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 9 inches long, each, | 3 50 |
| 614. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 10 inches long, each, | 4 00 |
| 615. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 11 inches long, each, | 5 00 |
| 616. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 12 inches long, each, | 5 50 |
| 617. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 14 inches long, each, | 6 00 |
| 618. German Silver Triangle, angles 30, 60 and 90 degrees, perpendicular 15 inches long, each, | 6 50 |
| 619. German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 4 inches long, | 2 00 |
| 620. German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 5 inches long, | 2 25 |
| 621. German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 6 inches long, | 2 75 |

No.		PRICE
622.	German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 7 inches long,	\$3 50
623.	German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 8 inches long,	4 00
624.	German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 9 inches long,	4 50
625.	German Silver Triangle, angles 45, 45 and 90 degrees, isosceles sides 10 inches long,	5 00

CROSS SECTION TRIANGLES.



630.



630.



630.

630. Cross Section Triangles, set of seven Cross Section Triangles made of hard rubber as follows, $\frac{1}{4}$ to 1, $\frac{1}{2}$ to 1, $\frac{3}{4}$ to 1, 1 to 1, $1\frac{1}{4}$ to 1, $1\frac{1}{2}$ to 1, 2 to 1, per set.

631. Single Triangles of set No. 630, each. 4 25
75

BATTER SLOPES.



635.

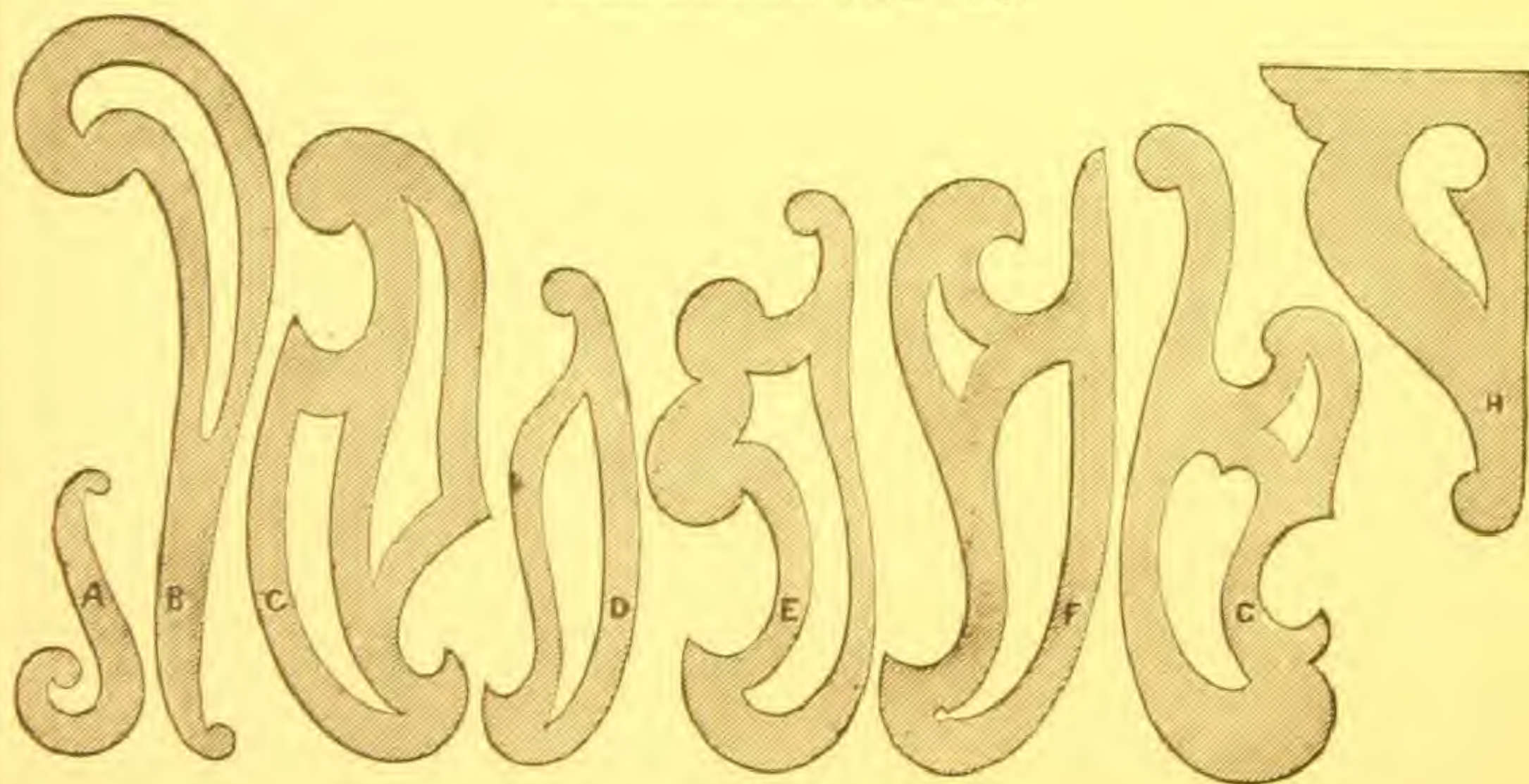


635.

635. Set of three forms of hard rubber for Batters of walls and rock, giving the following slopes, 1 in. 4, 1 in. 5, 1 in. 6, 1 in. 8, 1 in. 10, 1 in. 12, per set.

636. Single forms of set No. 635, containing any two slopes, each. 2 00
75

IRREGULAR CURVES.



649.

649. Whitewood Irregular Curves, 5 to 15 inches long, various patterns, each. 20



650.

No.		PRICE.
650.	Whitewood Irregular Curves, of superior quality, Nos. 1 to 6, each, .	\$ 25
650½.	Hard Rubber do. do. Nos. 1 to 6, each, 35 cts. Nos. 8 to 10, each,	50



651.

651.	Whitewood Irregular Curves, of superior quality, Nos. 13 to 21, each,	35
651½.	Hard Rubber do. do. Nos. 13 to 21, each,	75



652.

652.	Whitewood Irregular Curves, of superior quality, Nos. 23 to 25, each,	55
652½.	Hard Rubber do. do. Nos. 23 and 24, each, \$1.00. No. 25, each,	1 50



653.

No. 653. Hard Rubber Irregular and Ship Curves, 4 to 26 inches long, as used in the United States Navy Yards, complete set in wooden box. Price \$38 50

Price of each curve on next page, No. 654

654. Single Curves of set No. 653.

No. 1, 25 cents each; 2, 3, 45 cents; 4, 5, 6, 50 cents; 7, 8, 9, 10, 60 cents; 11, 12, 13, 14, 65 cents; 15, 75 cents; 16, 17, 18, 90 cents; 19, \$1.10; 20, 21, 22, 23, \$1.00; 24, 25, 35 cents; 26, 27, 28, 29, 30, 45 cents; 31, 32, 70 cents; 33, 34, 60 cents; 35, 36, 37, 70 cents; 38, 39, 40, 41, 42, 90 cents; 43, 44, 45, 46, 47, 48, 49, 50, 51, \$1.10.

RAILROAD REGULAR CURVES.

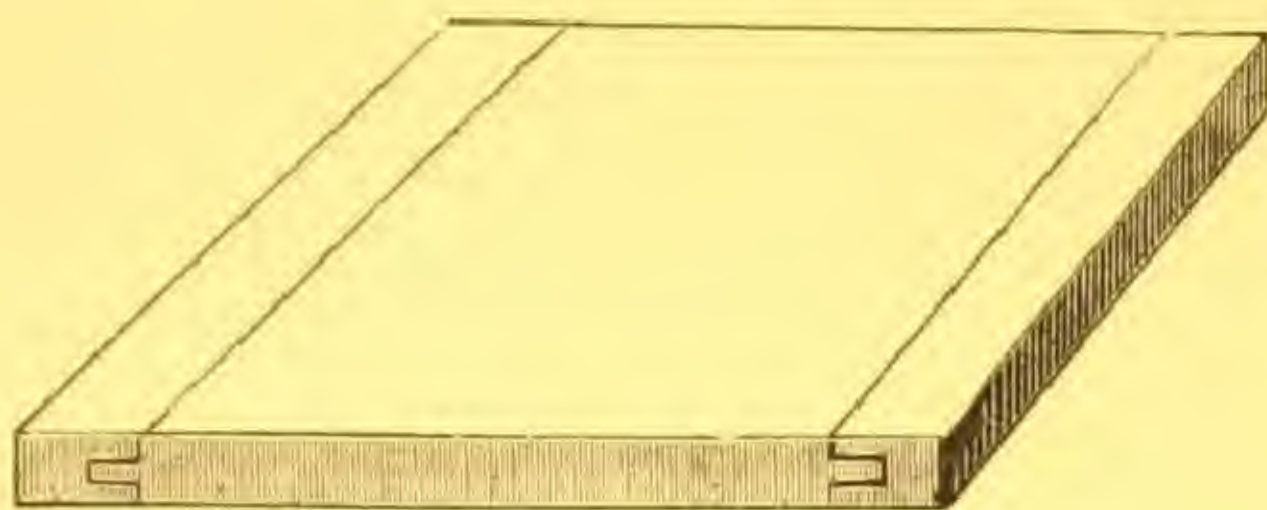


No.	PRICE.
660. Railroad Curves, of card board. Set of 24 curves, from $1\frac{1}{2}$ to 24 inches radii, in wood box, per set,	\$4 50
661. Railroad Curves, of card board. A set of 50 curves, from $1\frac{1}{2}$ to 120 inches radii, in wood box, per set,	9 00
662. Railroad Curves, of card board. A set of 100 curves, from $1\frac{1}{2}$ to 240 inches radii, in wood box, per set,	15 00
664. Railroad Curves, of wood. A set of seventy curves, from 25 minutes to 4 degrees by every 5 minutes, and from 4 degrees to 10 degrees by every 15 minutes, per set,	15.00
664 $\frac{1}{2}$. Railroad Curves, of hard rubber, same curves as No. 664, per set,	25.00
665. Railroad Curves, of wood. Set of 43 curves, of radii from $3\frac{1}{2}$ to 200 inches, per set,	9.00
665 $\frac{1}{2}$. Railroad Curves, of hard rubber, same curves as No. 665, per set,	18.00
666. Railroad curves, of wood. Set of 10 curves, 12 to 120 inches radii, in case, per set,	4.50
666 $\frac{1}{2}$. Railroad Curves, of hard rubber, same curves as No. 666, per set,	7.75
667. Railroad Curves, of wood, 12 to 60 inches radii, per set,	6 00
667 $\frac{1}{2}$. Railroad Curves, of hard rubber, same curves as No. 667, per set,	10.50
668. Railroad Curve Protractor, of horn, 8 inches diameter, having laid off on it 33 curves, from $\frac{1}{2}$ degree to 8 degrees, with a radii of 400 feet to the inch, each,	2.00
668 $\frac{1}{2}$. Ship Curves, of pearwood, set of 10 curves, per set,	5.50
669. Universal Curvilinear, in box,	5.00

With No. 669 an infinite variety of curved lines may be drawn, either in pencil or in ink. It is not necessary to make a design for any required curve, as the instrument, when set, shows the exact extent and curvature of the proposed line.



670. Hard Rubber Splines,						
	12	18	24	30	36	42 inch
each,	.25	.30	.35	.40	.45	.50
671. Pearwood Splines, 12 to 36 inches long, from						15 to .30
672. Lead Weights for Splines, each,						1.50
673. Lead Paper Weights, covered with leather, each,						1.00
674. Iron Paper Weights, round with knob, small, each,						.60
675. Do, do, square with knob, large, each,						1.00



676.

No.		PRICE.
676.	Drawing Board, of pinewood, well seasoned, clamped with cherry.	
Do.	do. cap size, 12 by 17 inches, each,	\$0.75
Do.	do. demy size, 16 by 21 inches, each,	1.15
Do.	do. superroyal size, 20 by 28 inches, each,	1.50
Do.	do. double elephant size, 28 by 42 inches, each,	2.75



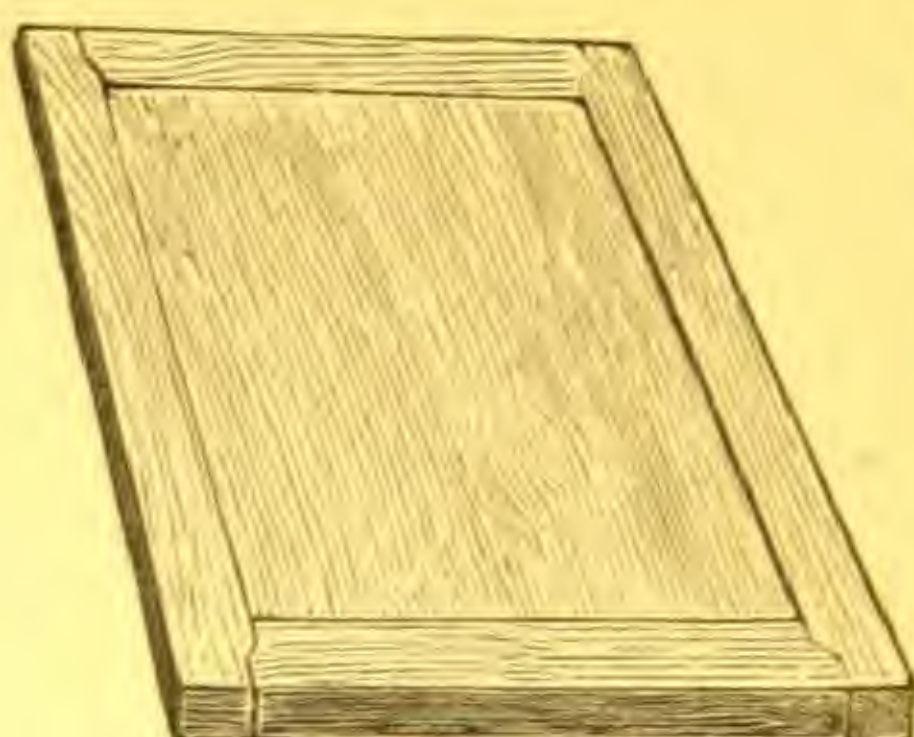
677.

677.	Drawing Board, pinewood, dovetailed hardwood batten.	
Do.	do. imperial size, 23 by 31 inches, each,	2.75
Do.	do. atlas size, 27 by 34 inches, each,	3.50
Do.	do. double elephant size, 28 by 42 inches, each,	4.00
Do.	do. antiquarian size, 33 by 54 inches,	7.50



678.

678.	Drawing Board, pinewood, hardwood battens screwed to the back. The screws run in slots, to allow free contraction or expansion.	
Do.	do. demy size, 16 by 21 inches, each,	1.50
Do.	do. royal size, 20 by 26 inches, each,	2.25
Do.	do. imperial size, 23 by 31 inches, each,	3.50
Do.	do. double elephant, 28 by 42 inches, each,	5.50

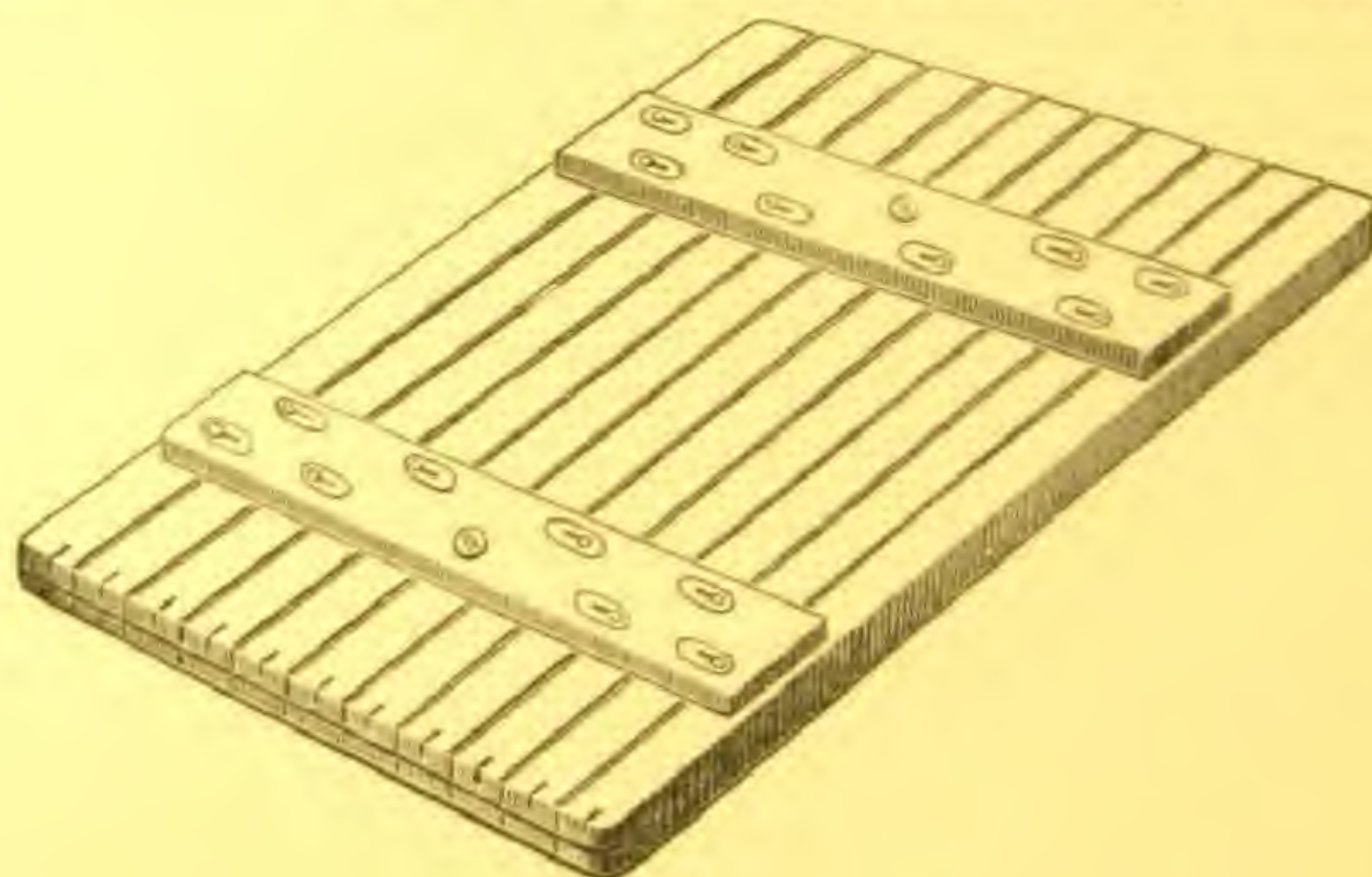


679.



679.

No.			Price.
679.	Walnut-framed Drawing Board, centre of pine and removable.		
Do.	do.	half royal size, 10½ by 17 inches,	\$2.00
Do.	do.	half imperial size, 14 by 19 inches,	2.50
Do.	do.	royal size, 17 by 22 inches,	3.50
Do.	do.	imperial size, 19 by 28 inches,	4.50
Do.	do.	double elephant size, 24 by 38 inches,	7.00



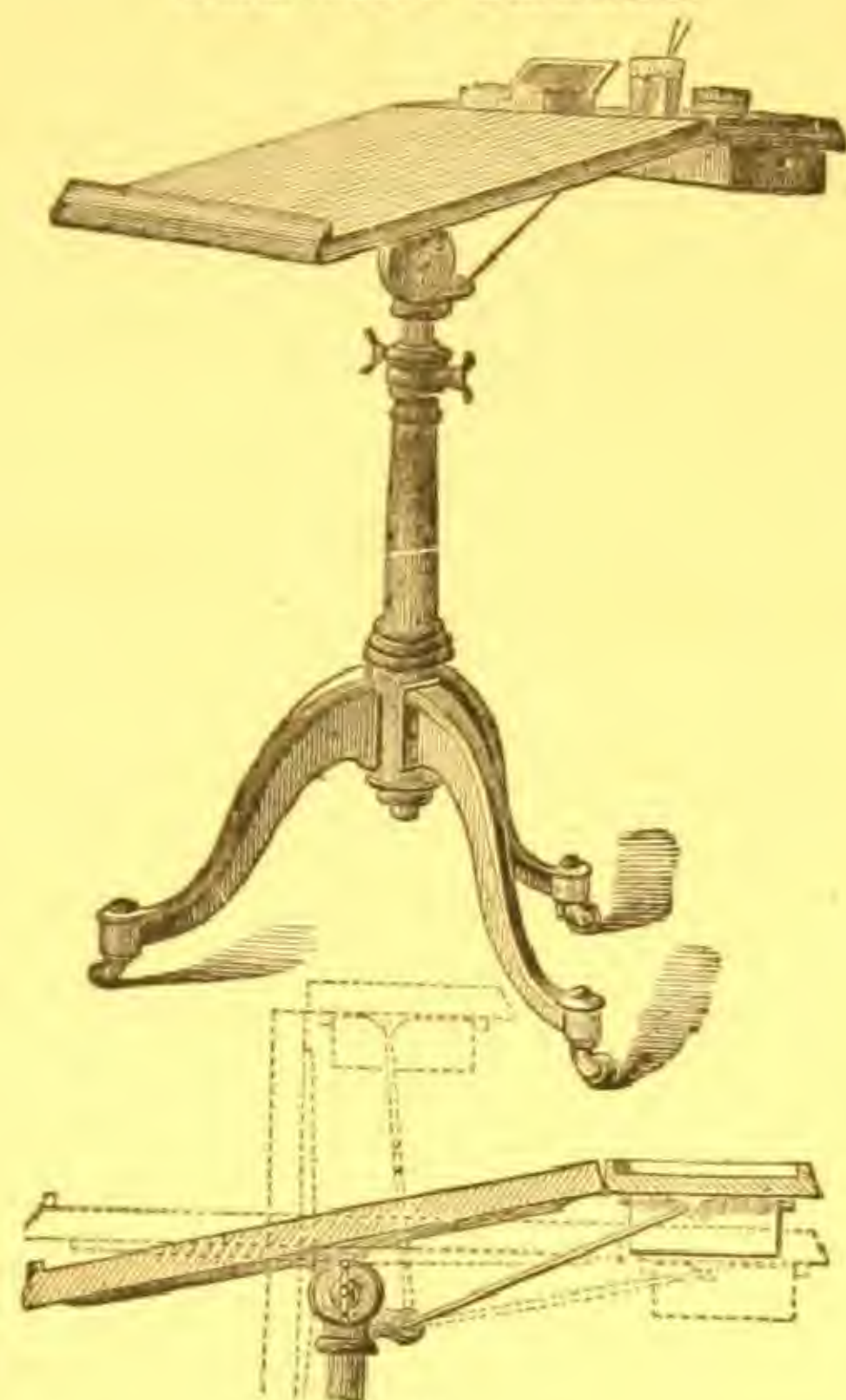
680.

680.	Drawing Board, pinewood, hardwood battens.		
Do.	do.	demy size, 15 by 21 inches,	3.00
Do.	do.	royal size, 20 by 26 inches,	4.50
Do.	do.	imperial size, 23 by 31 inches,	6.00
Do.	do.	double elephant size, 31 by 42 inches,	8.50
Do.	do.	antiquarian size, 33 by 55 inches,	12.00

The Drawing Board above illustrated is the best, and deserves recommendation, as it is the only one which possesses the qualities a good and true board should have. It is made of pinewood, glued up to the required width, with the heart side of each piece of wood to the surface. A pair of hardwood battens are screwed to the back, the screws pass through the ledges in oblong slots, bushed with brass, which fits closely under the heads and yet allows the screws to move freely when drawn by the contraction of the board. To give the battens power to resist the tendency of the surface to warp, a series of grooves are sunk in half the thickness of the board over the entire back. These grooves take the transverse strength out of the wood to allow it to be controlled by the battens, leaving at the same time the longitudinal strength of the wood nearly unimpaired.

To make the two working edges perfectly smooth, allowing an easy movement with the square, a slip of hardwood is let into the end of the board. The slip is afterwards sawn apart at about every inch to admit contraction.

DRAWING TABLES.

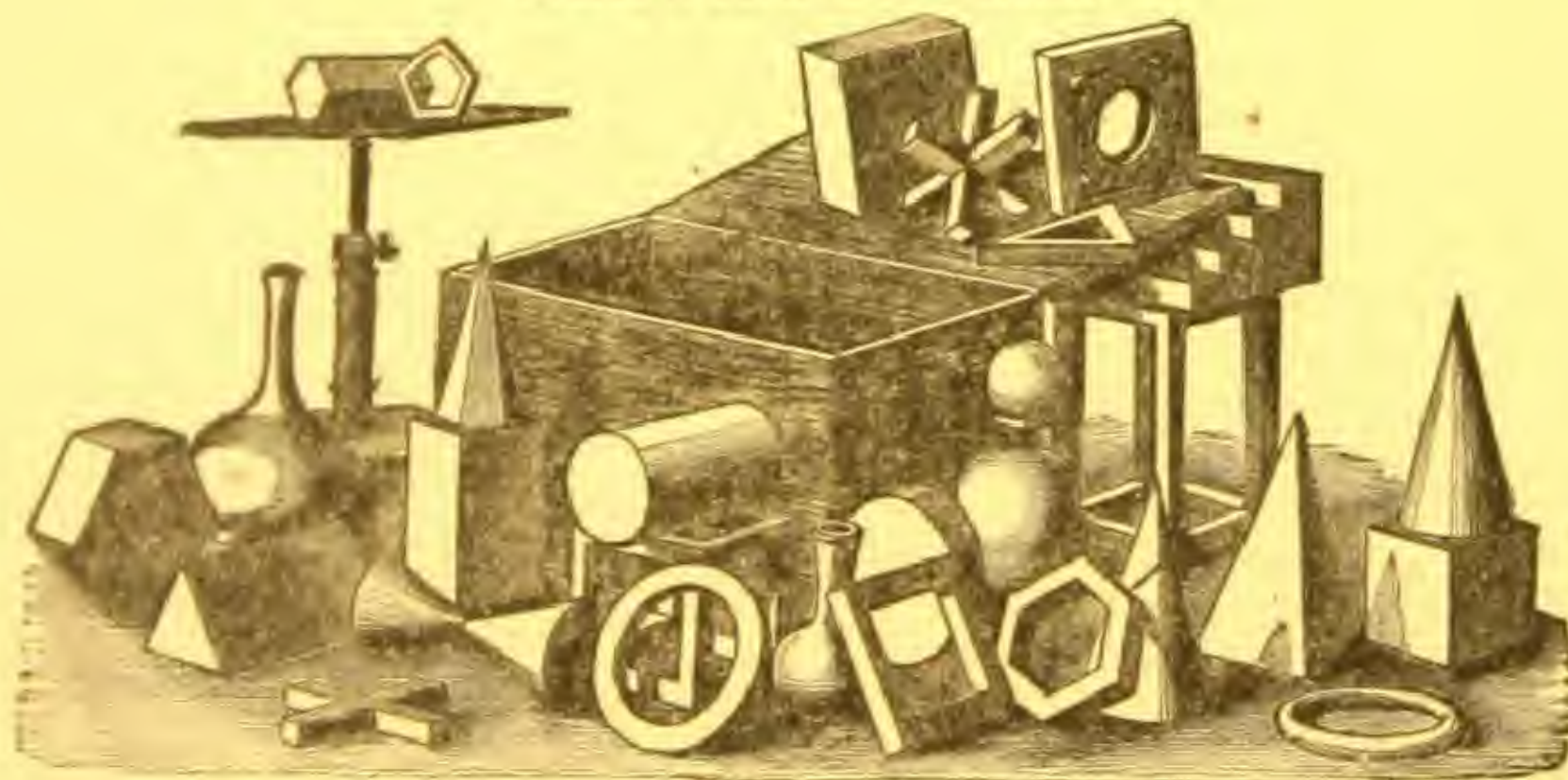


681.

681. Drawing Table, black walnut top, 22 by 26 inches, instrument shelf 7 by 26 inches, two instrument drawers, ornamented iron stand, mounted on castors, each, \$12 50
682. Similar to No. 678, top of selected, polished walnut, iron stand, bronzed and tastefully ornamented, 15 50

These tables, suitable for architects' offices, counting-rooms, &c., or for home use, can be readily fixed at any height from 30 to 44 inches, with the top horizontal, vertical, or inclined at any angle, while the instrument shelf and drawers always remain level. In any of these positions the top can be allowed to rotate, or the whole firmly clamped. Total weight, 55 pounds.

DRAWING MODELS.



683.

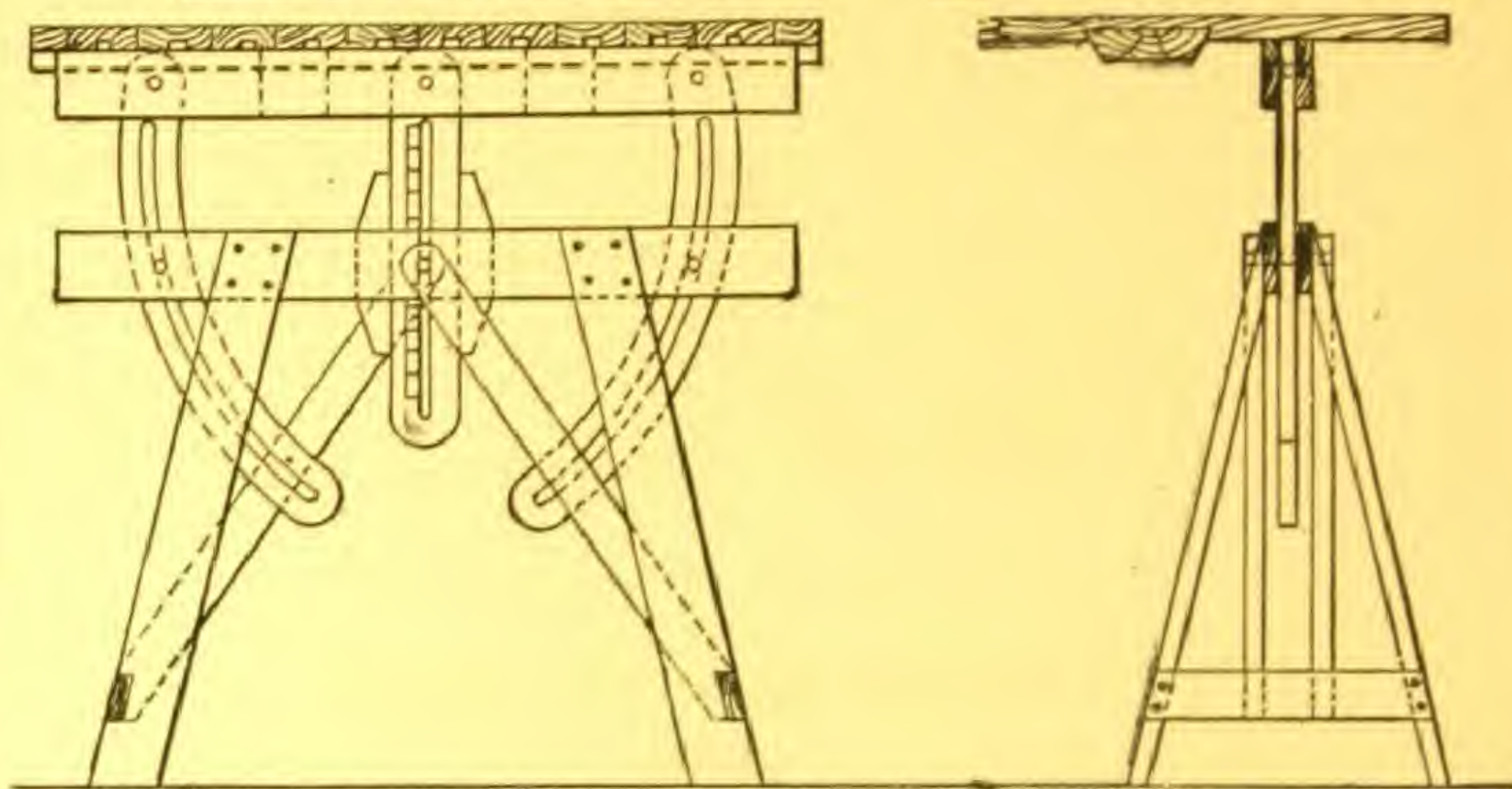
683. New American Drawing Models, a set of 27 pieces, consisting of mathematical solids, vases, &c., with stand, complete in a substantial box, per set, 25 00

684.

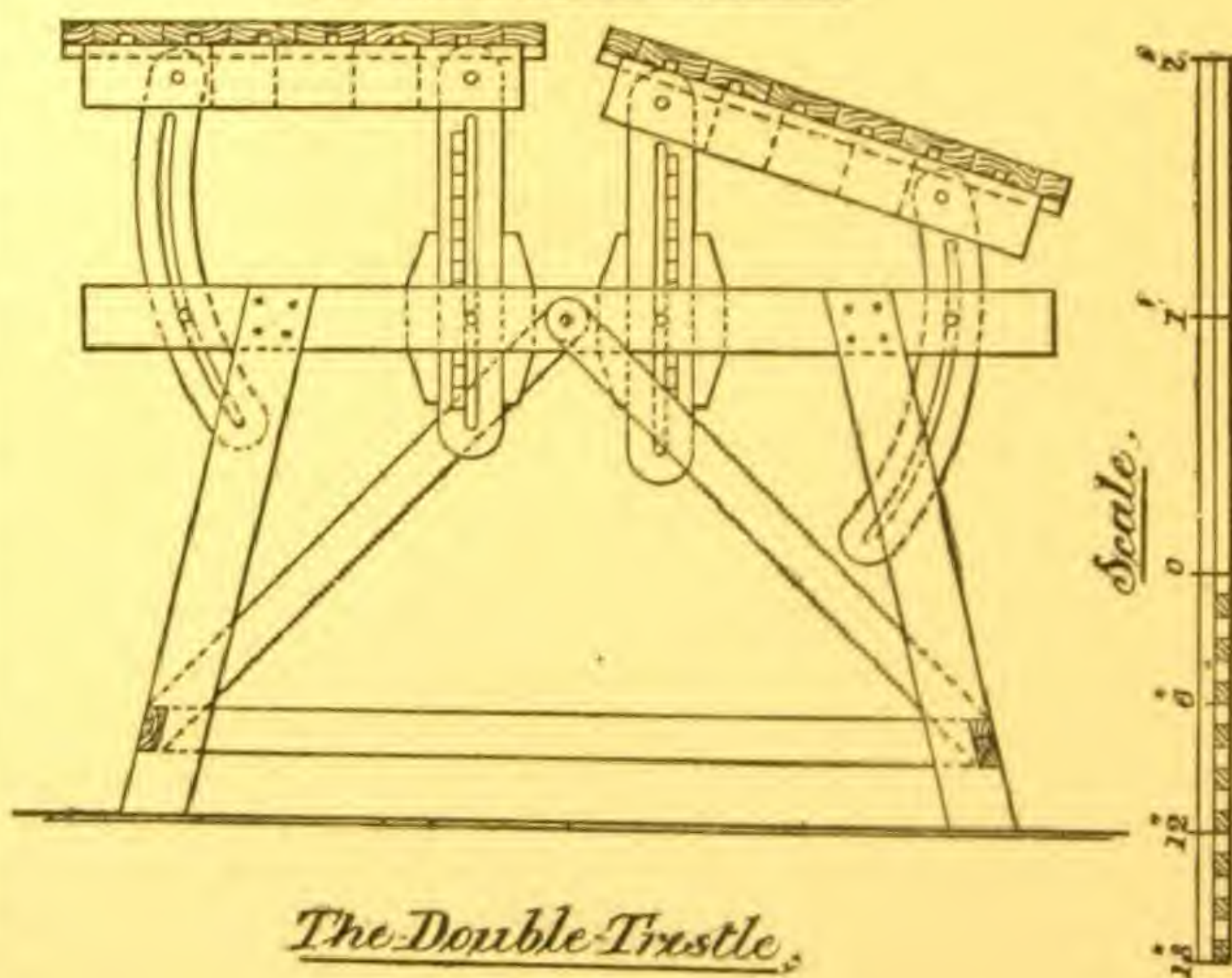
Harden's Patent Adjustable Drawing-Board Trestle.

Side Elevation. FIG. 1.

End Elevation. Fig. 2.



Side Elevation. FIG. 3.



Patented Dec 3rd 1873 by J. H. Harden.

The Double-Tristle.

685.

684.	Single Trestle, per pair,	.	.	.	.	.	.	.	\$10.50
685.	Double Trestle, per pair,	.	.	.	.	.	.	.	12.50

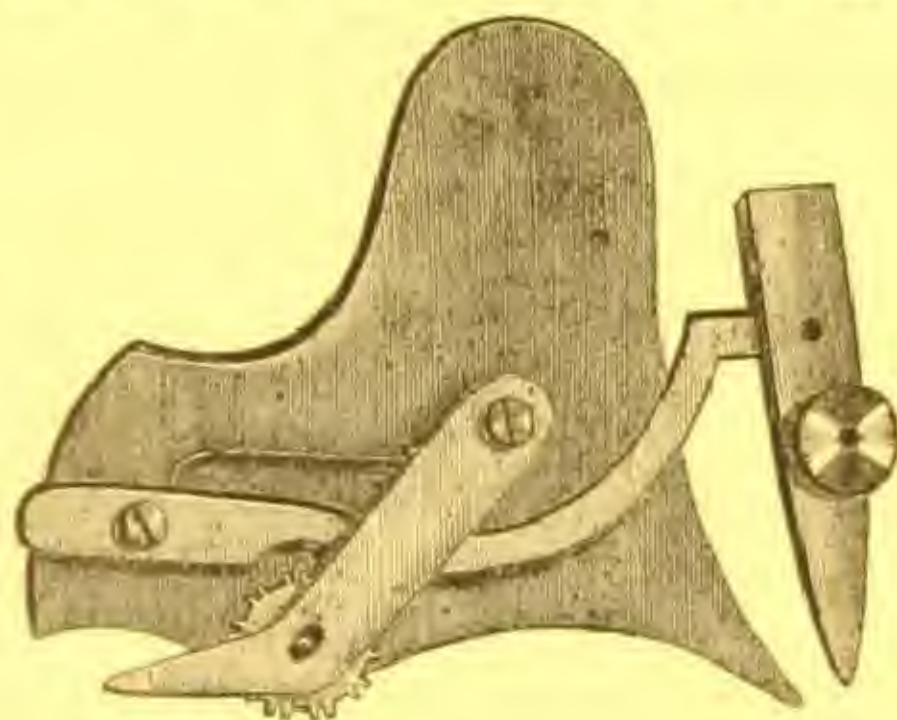
HARDEN'S PATENT ADJUSTABLE DRAWING-BOARD TRESTLE.

This invention consists in the application of curved and straight Slot Links, Thumb-screws, and an additional Bearing-bar to trestles of the ordinary form, by which means adjustment to the height of the Draughtsman is obtained, sitting or standing, from the height of a table to the full height of a drawing-board, from the horizontal to any required angle of inclination on either side.

Figures 1 and 2 show side and end elevations of Trestle, suitable for the Artist, Engineer, or Architect's office.

Figure 3 shows the side elevation of a Double Trestle for the use of Mechanics, Schools, and Colleges, or where it may be desirable to economize space.

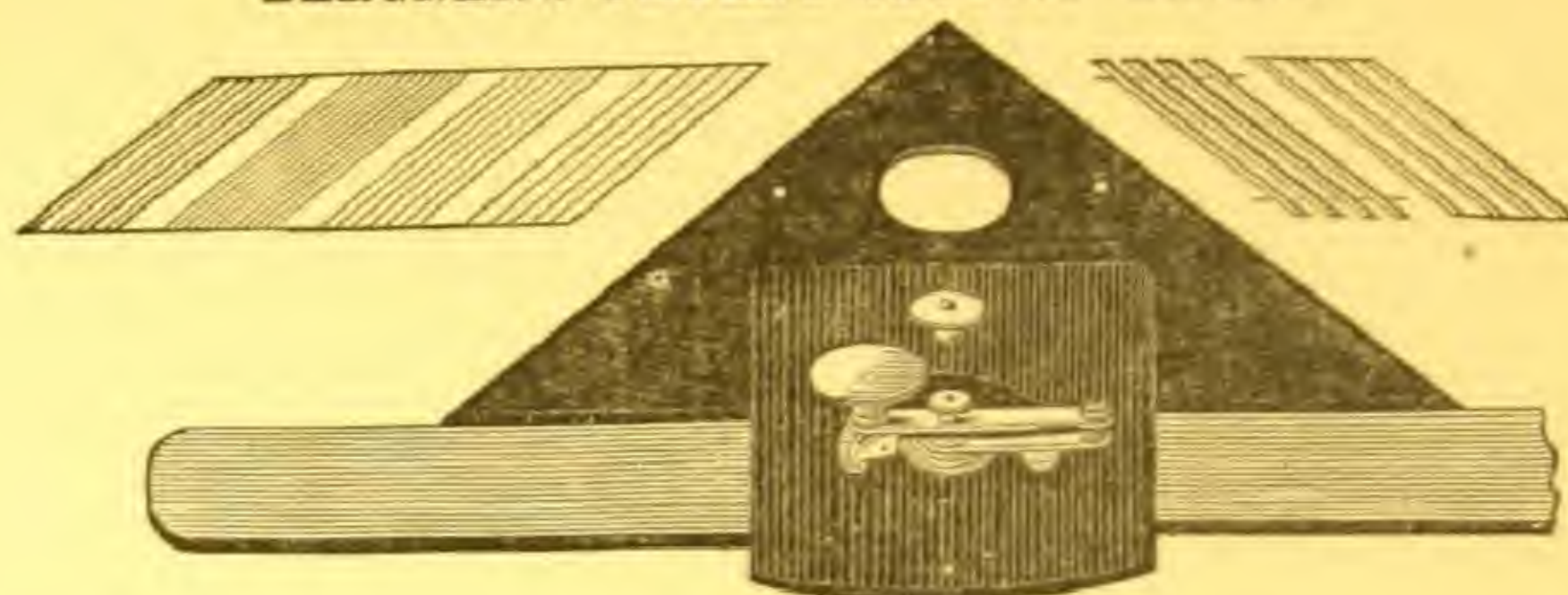
REFERENCES.—Prof. T. W. Richards, Architect, 3332 Chestnut St., Philadelphia; F. Brotherhood, Taylor Iron-Works, Charleston, S. C.; Prof. J. M. Silliman, Lafayette College, Easton, Pa.; Prof. L. M. Haupt, University of Pennsylvania, West Philadelphia; E. B. Coxe, Jeddo, Luzerne Co., Pa.; Prof. J. P. Lesley, State Geologist, 1008 Clinton Street, Philadelphia; Franklin Institute Exhibition (diploma awarded).

DOTTING PEN AND EXTRA WHEELS.

Dotting Pen, with extra Wheels, \$3.75

This instrument answers the purpose of making dotted lines better than any other yet made. It consists of a small, conveniently-shaped German silver plate, upon which is fastened a Pen, connected by a small bar, and a ratchet movement with a rolling wheel. The bar is kept in its place by a small spring. Extra wheels of different patterns accompany the instrument, which, being readily changed, allow the making of various forms of lines. In using the instrument, care should be taken that the small point behind the pen rests on the paper, as it secures evenness in the stroke of the pen.

BERGNER'S PATENT SECTION LINER.

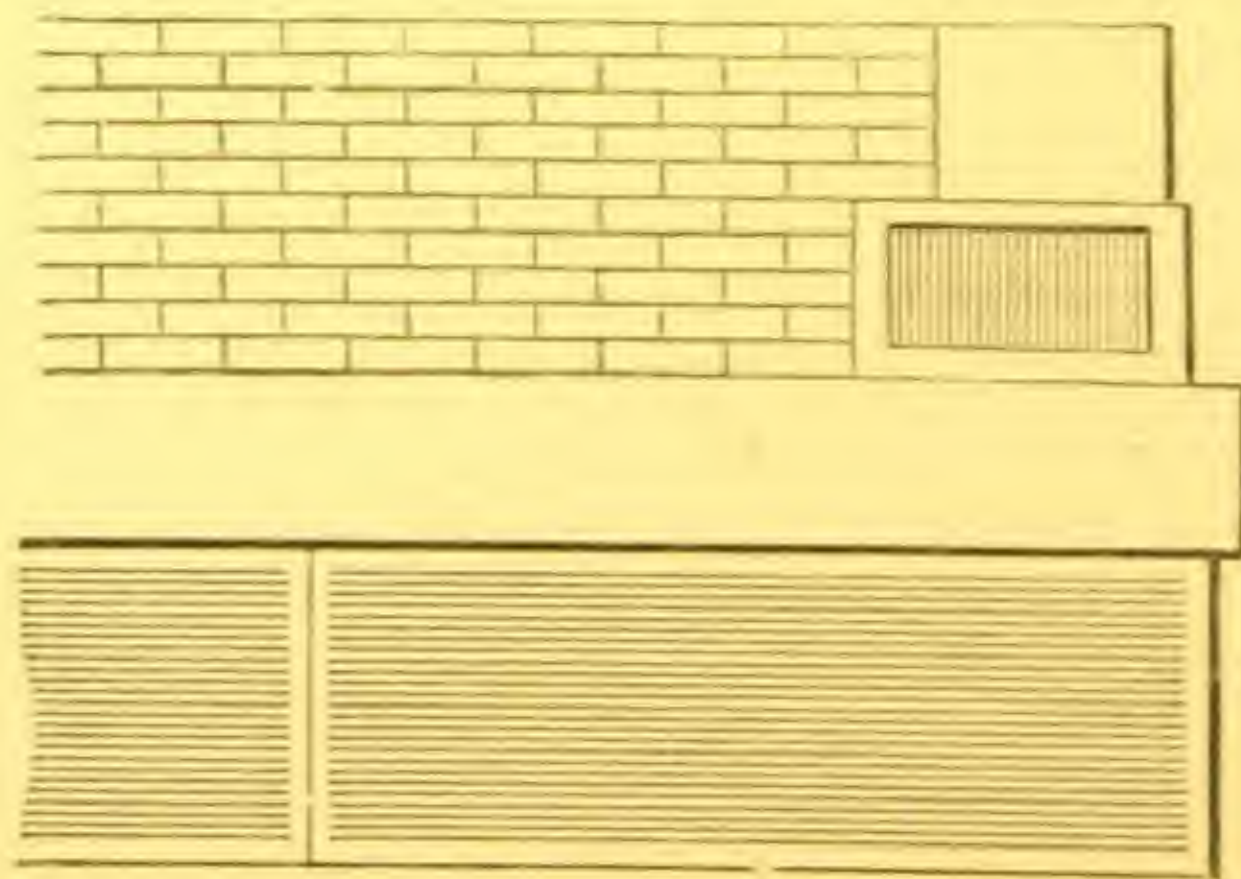
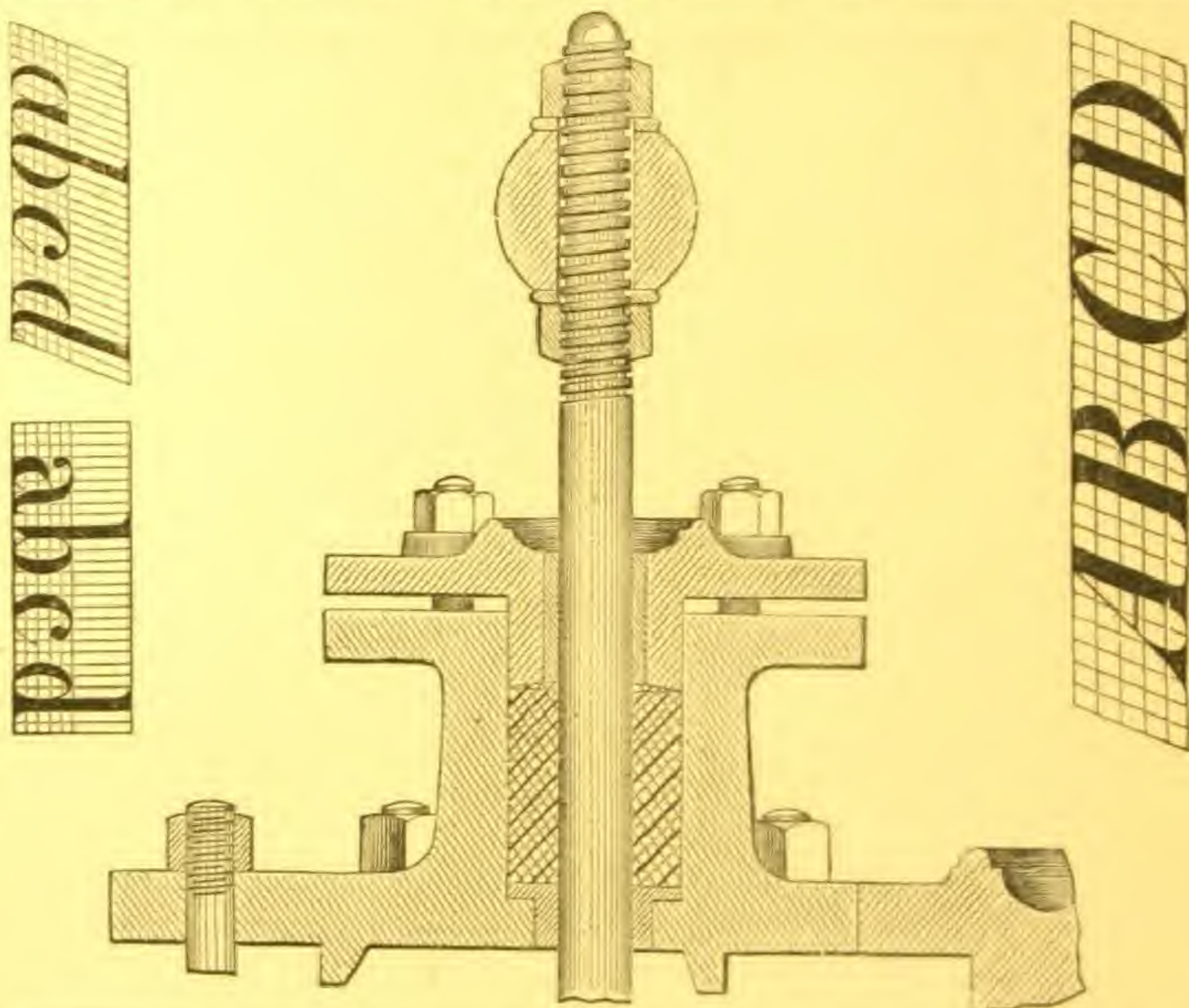


686.

686. Bergner's Patent Section Liner, in morocco case,

\$12 00

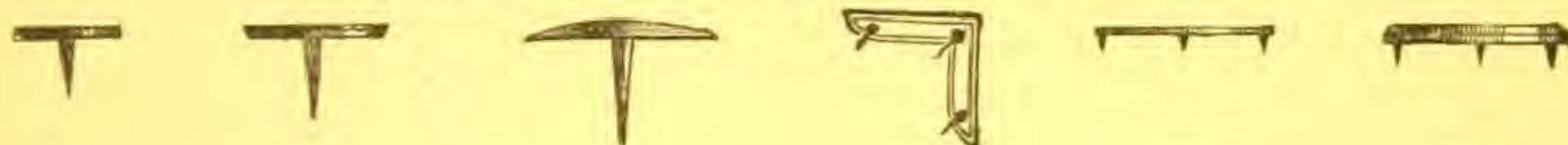
SAMPLES OF WORK DONE WITH BERGNER'S PATENT SECTION LINER.



This Instrument is for indicating sections of objects in mechanical and architectural drawings, for drawing screw threads, laying out the spaces for brick work, letterings on drawings, and all cases where narrow spaced parallel lines are needed. With it, a person of moderate ability or practice can produce an effect of uniformity and neatness, in sectional drawings, almost, or quite equal to the engine dividing of engravings. The instrument consists

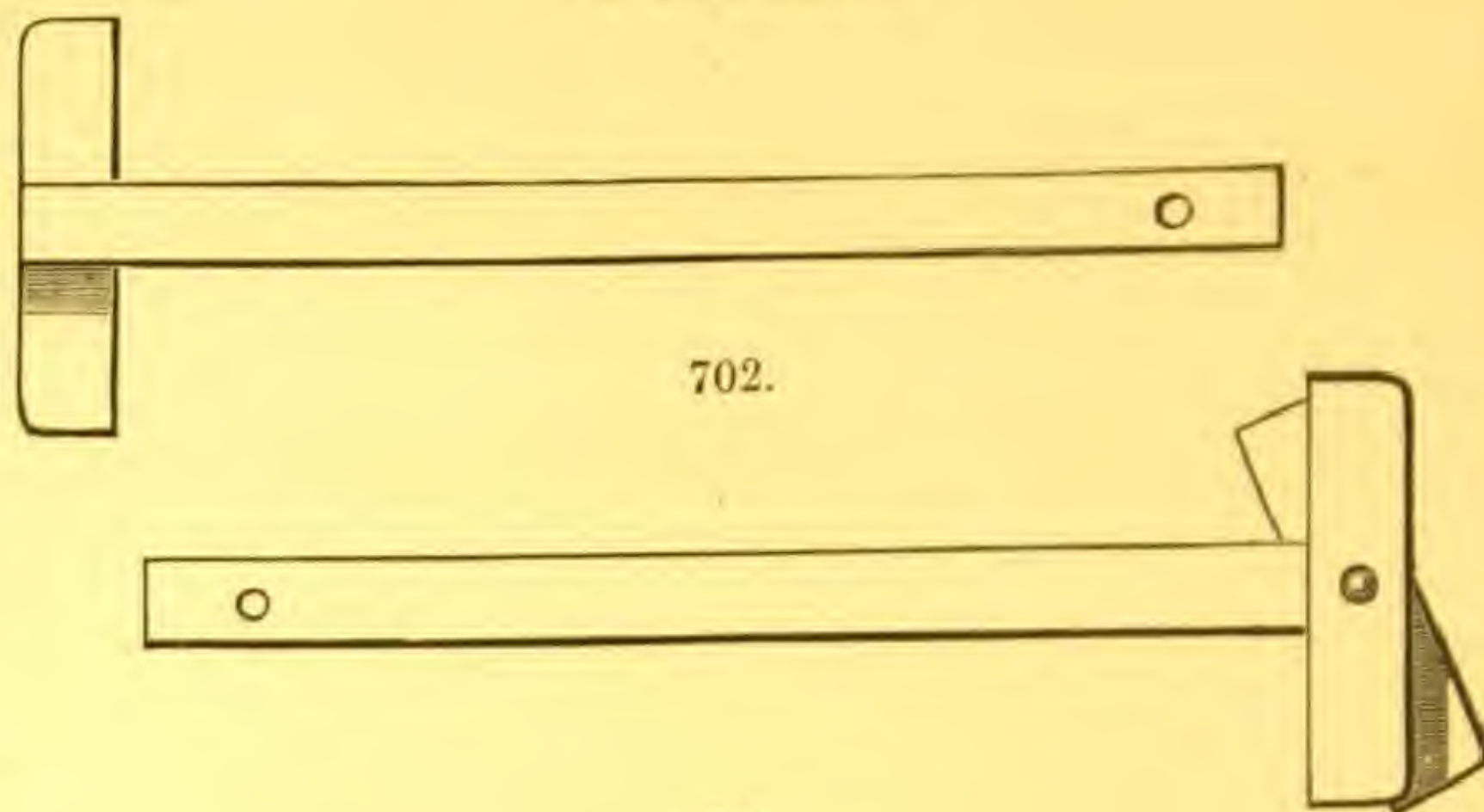
of a ruler, covered on the under side with india-rubber cloth, a triangle with a clamping-screw, passing through near one of its edges, and a plate, with the necessary arrangement for producing a movement over equal spaces. The several parts are placed together as represented in the engraving, there being a little spring beneath the front edge of the top plate, which presses against one edge of the ruler while the triangle is clamped against the other edge. The ruler may be placed upon the paper in any desired position, the india-rubber cloth underneath keeping it there with perfect security, and it thus acts as a guide for the triangle, which can be moved along over equal steps by alternately pressing down the ivory button and letting it spring back. This movement is produced by the action of a little pawl upon the ruler, which is always to be kept pretty sharp so that it will take a quick and certain hold. The length of the steps taken, or the distance between the lines drawn, is regulated by the screw above the spring, the distance moved over each time being greater as the spring is allowed to have more play. By changing the clamping-screw on the triangle, any edge can be placed against the ruler.

FASTENING TACKS AND HORN CENTRES.



No.						PRICE.
690.	Fastening Tacks, of Brass, heads flat, $\frac{1}{4}$ inch diameter, .				per doz.	\$0.20
691.	Do. do. do. heads round, $\frac{1}{4}$ inch diameter, .				do.	.25
692.	Do. do. do. do. $\frac{7}{8}$ do. .				do.	.35
693.	Do. do. of German Silver, heads rounded, $\frac{1}{4}$ in. diam.,				do.	.45
693 $\frac{1}{2}$.	Do. do. do. do. $\frac{7}{8}$ do. .				do.	.50
694.	Do. do. do. flat heads, $\frac{5}{16}$ in. diam., very superior, do.				do.	.60
695.	Do. do. do. do. $\frac{7}{8}$ do. do. do.				do.	.65
696.	Do. do. do. do. $\frac{9}{16}$ do. do. do.				do.	.75
697.	Do. do. do. do. $\frac{9}{16}$ do. do. do.				do.	.85
697 $\frac{1}{2}$.	Do. do. do. do. $\frac{9}{16}$ do. do. do.				do.	1.00
697 $\frac{3}{4}$.	$\frac{1}{2}$ inch diam. extra long Needle Points, .				do.	1.00
698.	Fastening Tacks, of Steel, round heads, $\frac{1}{4}$ inch diameter, .				do.	.40
699.	Do. do. of Brass, right angled, .				do.	.75
700.	Horn Centre, each, .					.15
701.	Do. with German Silver Rim, each, .					.35
701 $\frac{1}{2}$.	Thumb Tack Extractor and Impressor, also Paper Knife. By using this handy little instrument, the bending of the pins and wrenching off of the heads is avoided. Price, Nickel Plated, .					.25

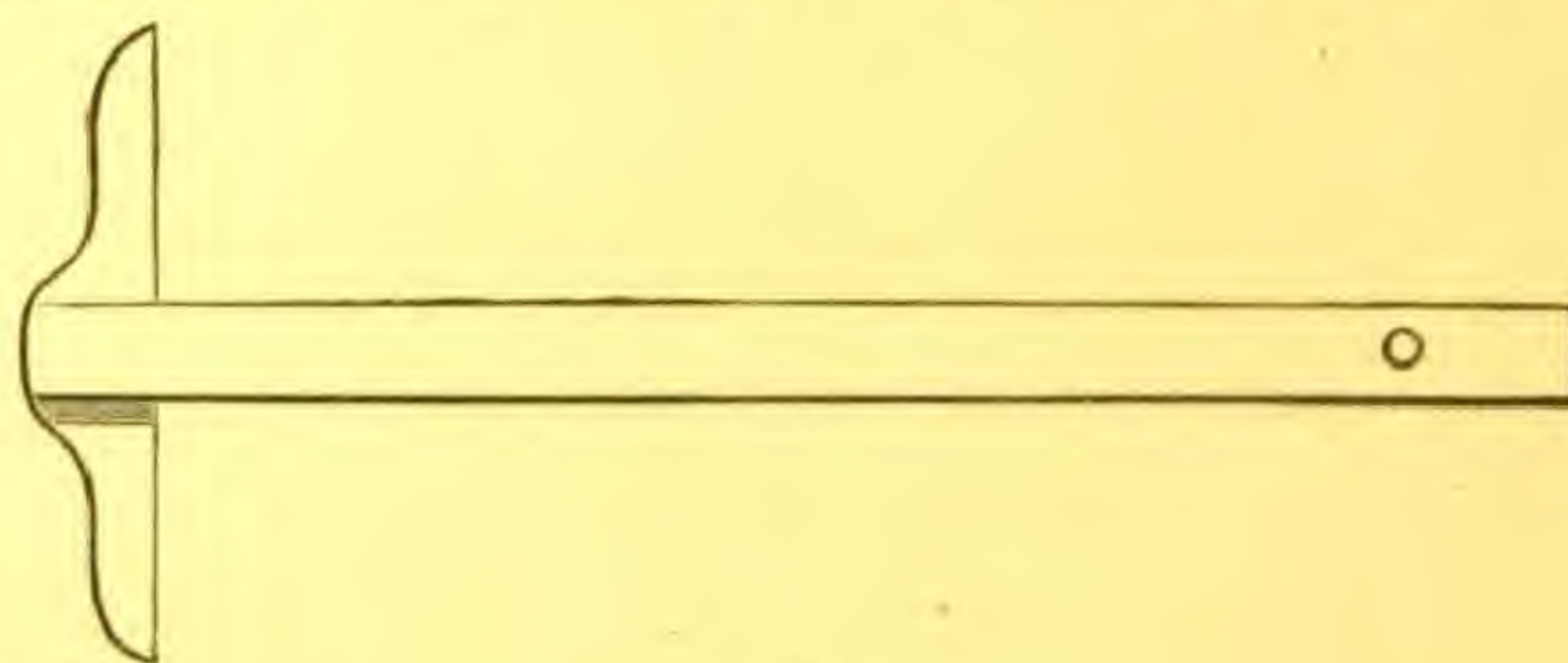
T SQUARES.



702.

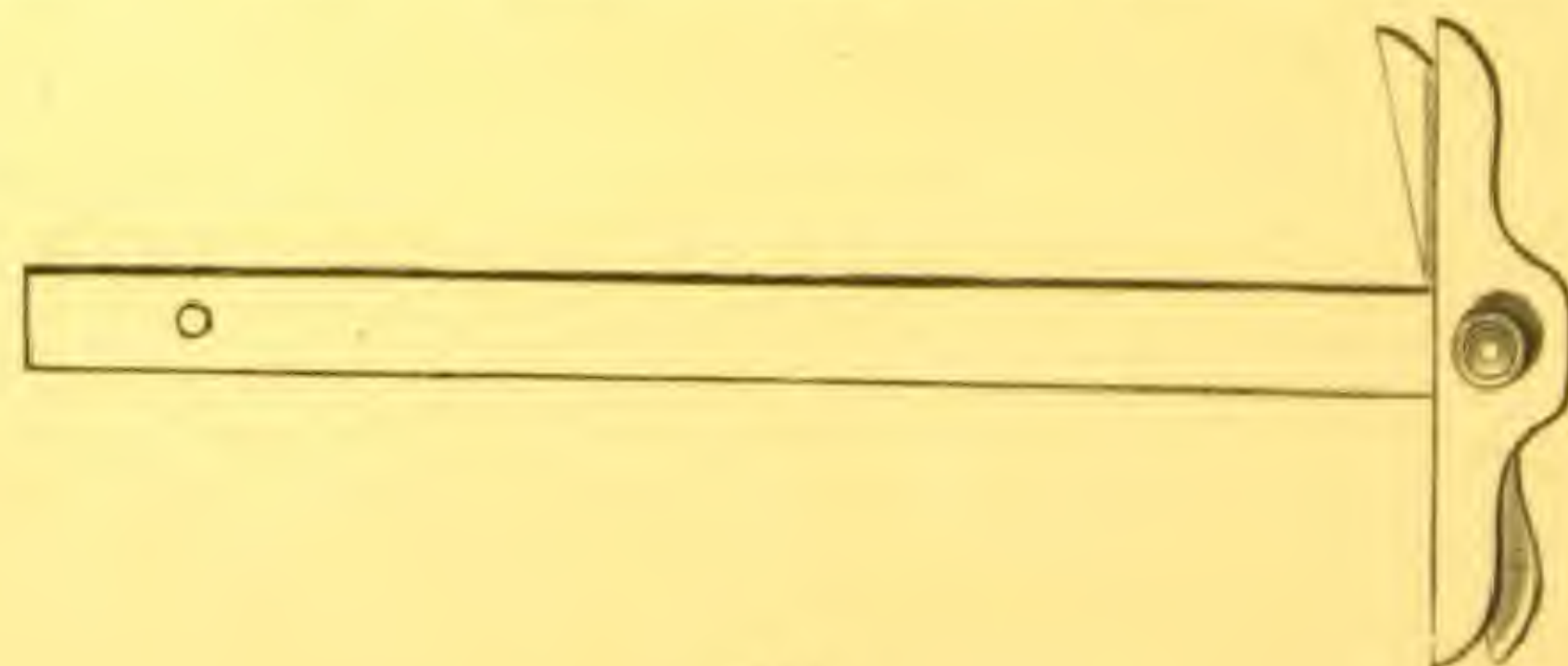
703.

No.									
702.	Pearwood T Square, fixed head.								
	15	20	25	30	35	40	45	50	70 inches long.
	.35	.45	.50	.60	.75	.85	\$1.00	1.25	2.00
703.	Pearwood T Square, shifting head.								
	20	25	30	35	40	50			70 inches long.
	\$1.00	1.10	1.20	1.35	1.50	1.75			2.50



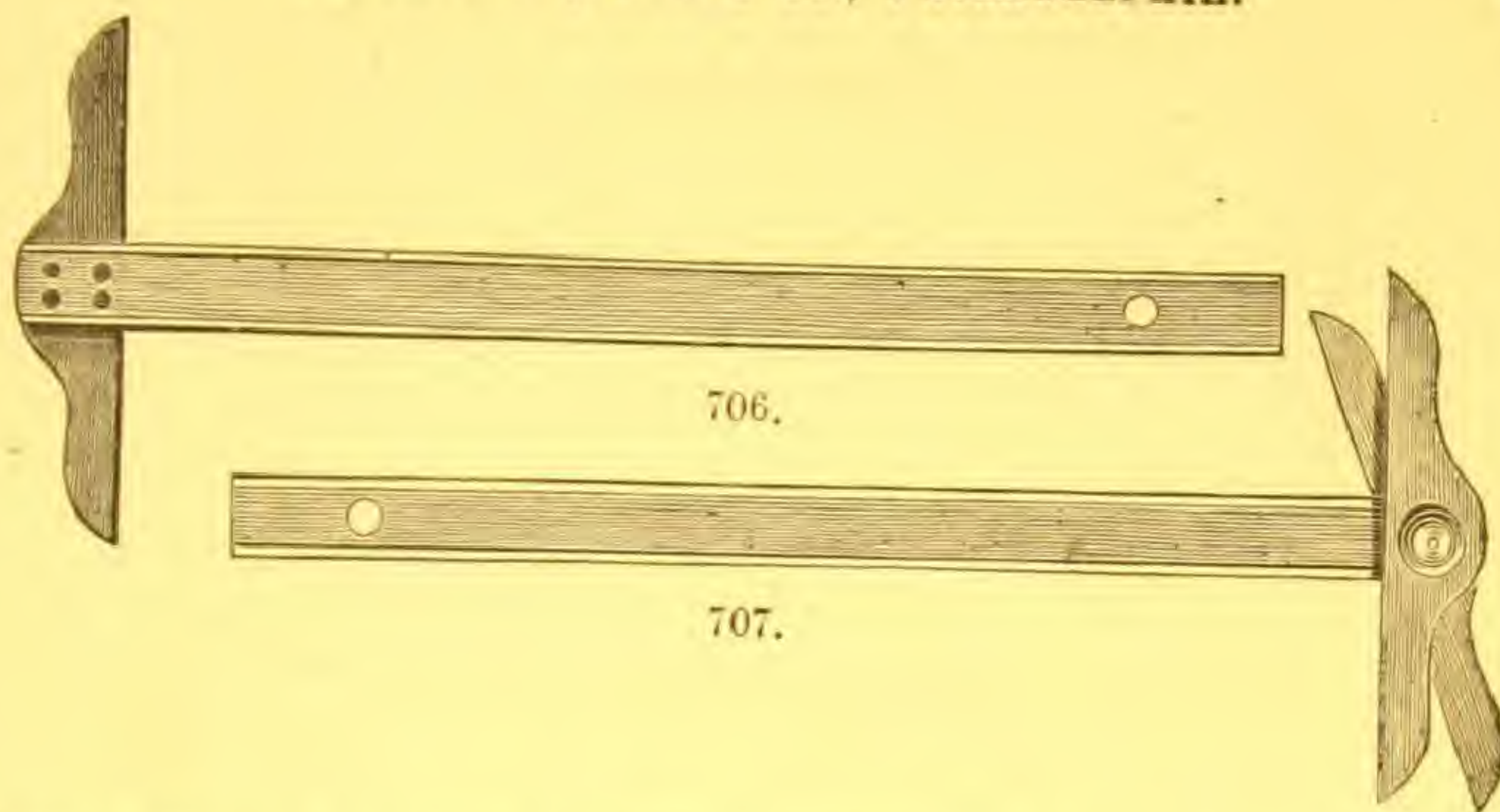
704.

704.	Maple Blade, Black Walnut Head, fixed.							
	20	25	30	35	50			60 inches long.
	.65	.75	.85	\$1.00	1.25			1.60

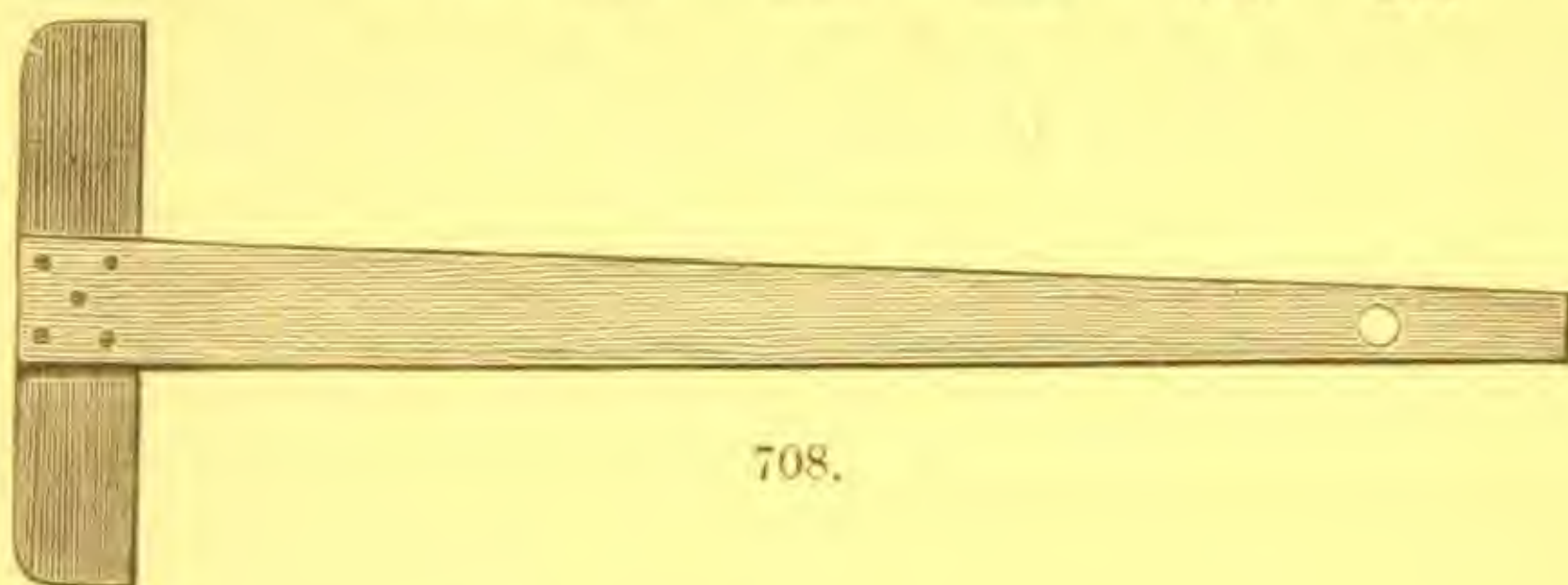


705.

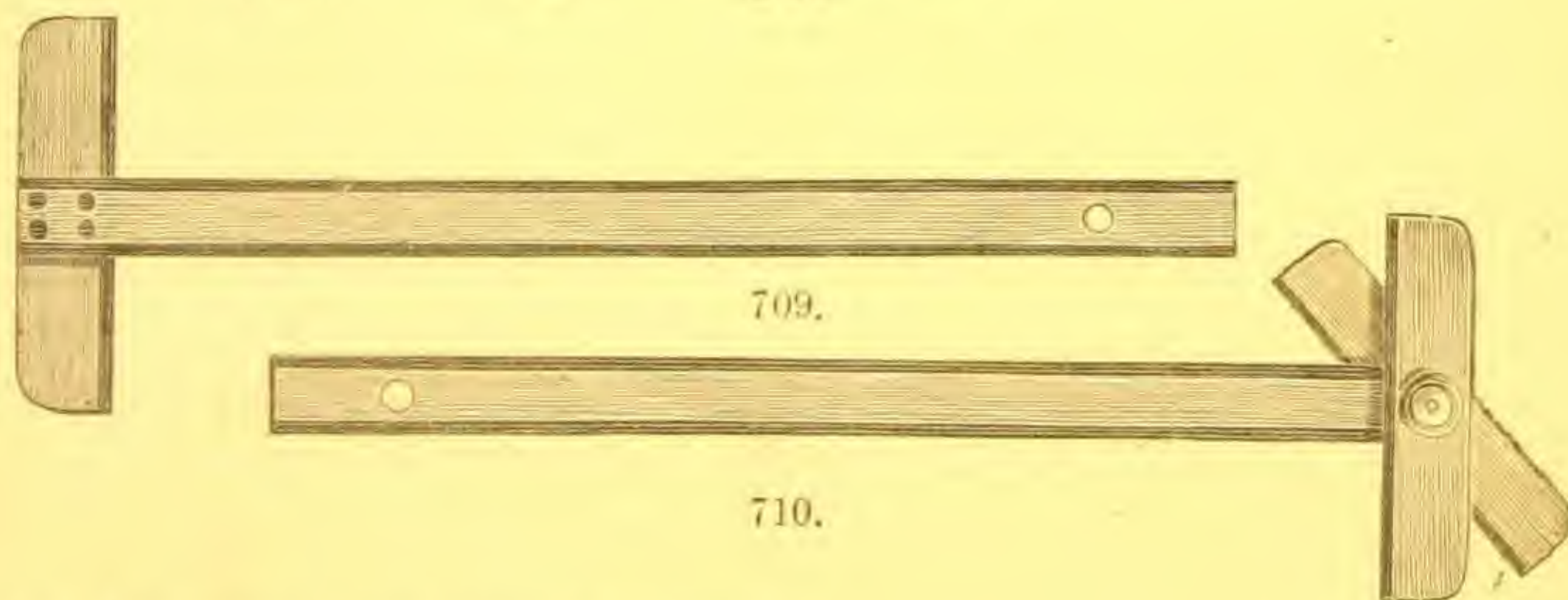
705.	Maple Blade, Black Walnut Head, shifting.							
	20	25	30	40				55 inches long.
	\$1.10	1.25	1.40	1.60				2.00



No.								
706.	Black Walnut T Squares, white hard maple lined Blades, fixed.							
	25	30	35	50	60	inches long.		
	\$1.00	1.15	1.25	1.75	2.50			
707.	Black Walnut T Squares, white hard maple lined Blades, shifting head.							
	25	30	35	40	48	54	60	72 inches long.
	\$1.50	1.60	1.75	2.00	2.25	2.50	3.00	4.00



708.	Hardwood Blade, tapered, Black Walnut Head.		
	30	40	50 inches long.
	\$1.25	1.75	2.00



709.	Mahogany, Ebony lined, fixed heads.				
	25	30	35	50	60 inches long.
	\$1.25	1.50	1.75	2.50	4.00
710.	Mahogany, Ebony lined, shifting head.				
	25	30	35	50	60 inches long.
	\$2.25	2.50	2.75	3.50	5.00



711.

No.	Rubber Blades, Black Walnut Head, fixed.					PRICE
	12	15	20	25	30	36 inches long.
	.90	\$1.00	1.25	1.50	2.25	2.75



712.

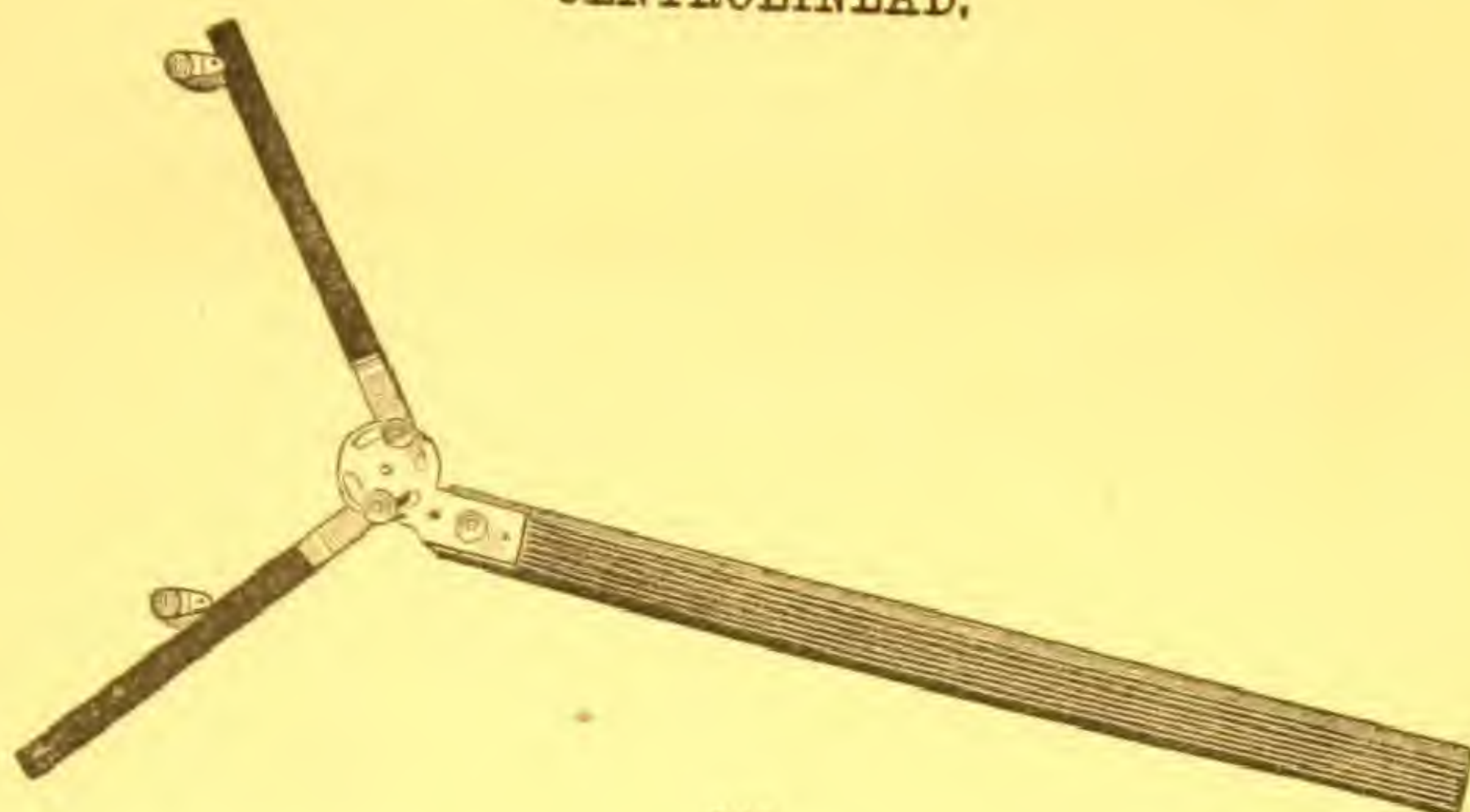
712. Rubber Blades, Black Walnut Head, shifting.	15	20	25	30	35 inches long.
	\$1.75	2.00	2.50	3.00	3.50
713. Steel Blades Nickel Plated, Japanned Iron Heads.	18	24	30	35 inches long.	
	\$3.25	4.50	5.50	6.50	
714. Steel Blades Nickel Plated, Japanned Iron Heads, shifting head.	18	24	30	35 inches long.	
	\$4.75	6.00	7.00	8.00	
715. Bronze Heads, Steel Blade, with Protractor Head, graduated to half degrees, blade 36 inches long.					\$16.00



716.

716. Brass Swivel for T Square, with nut and washer,	.	.	.	.	.60
717. Same as 716, but of German silver,	.	.	.	.	.85

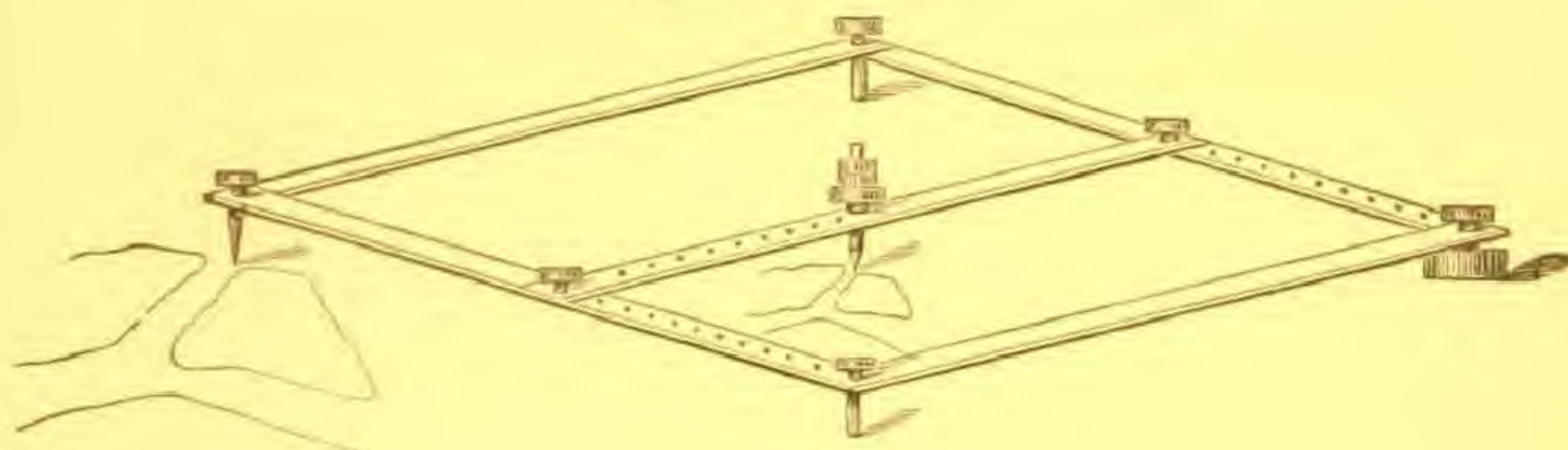
CENTROLINEAD.



733.

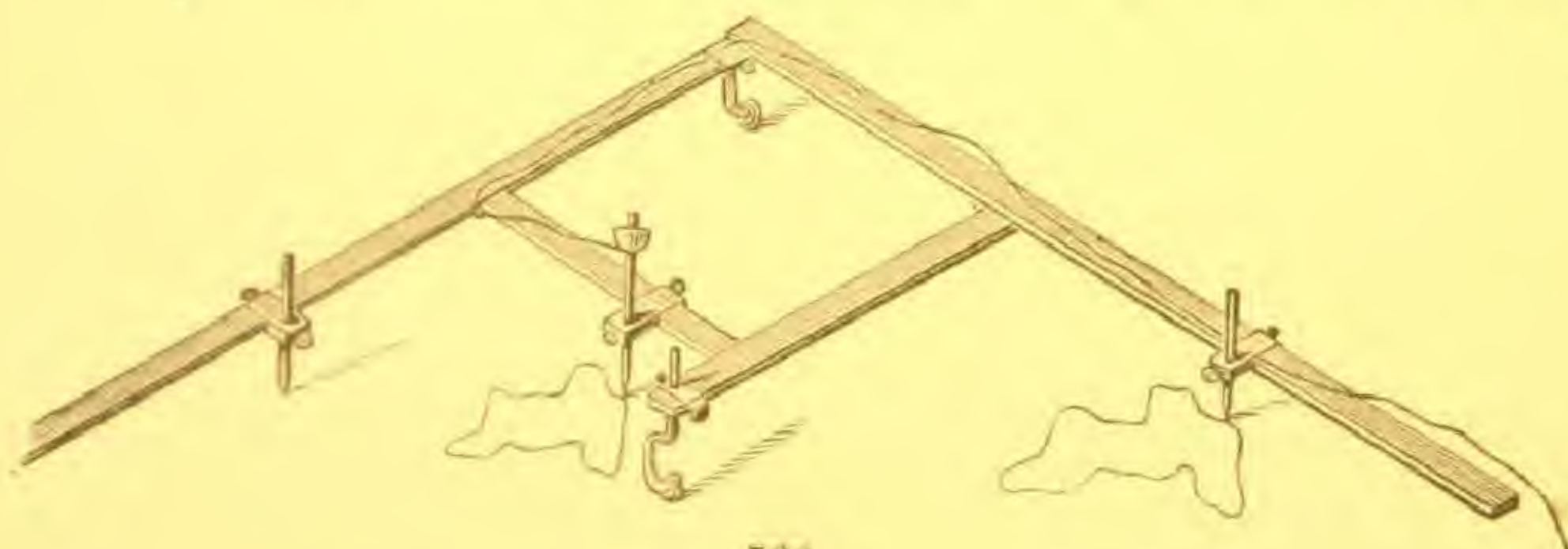
No.							PRICE.
733.	Centrolinead,	of wood,	for perspective drawing,	arms 24 inches,	.	.	\$5.00
733½.	Do.	do.	do.	do.	do.	36 do.	6.50

PANTOGRAPHS.



734.

734.	Pantograph of hardwood arms,	.	.	.	.	.	3.00
735.	Do. pearwood, arms 22 inches long,	.	.	.	.	.	5.50



736.

736.	Pantograph of black wood, with Brass Joints and Mountings. Iron and Lead Weights and complete Fittings, of good construction, for fine work, arms 20 inches long, in case, each,	.	.	.	.	.	18.00
737.	Pantograph of ebony, in box, arms 24 inches long,	.	.	.	.	.	25.00
738.	Do. brass, do. 24 do.	.	.	.	.	.	60.00
739.	Do. do. do. 30 do.	.	.	.	.	.	70.00

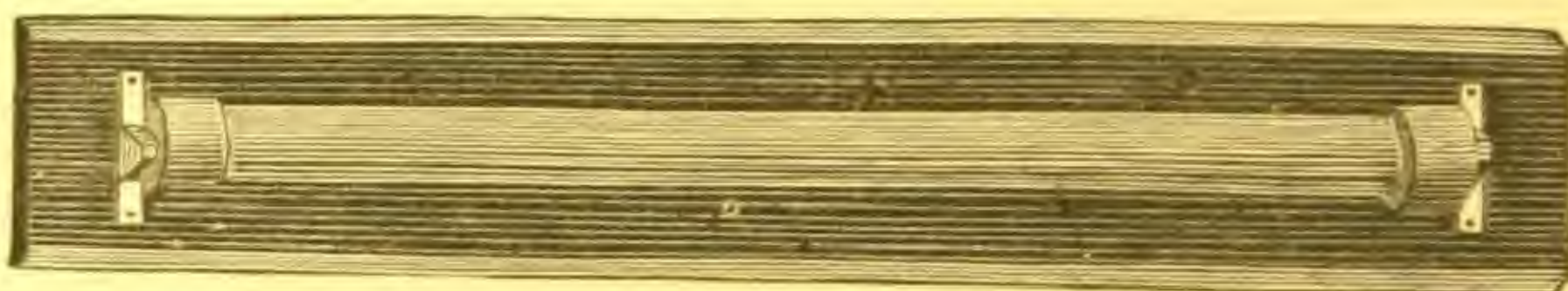
PARALLEL RULERS.



750.

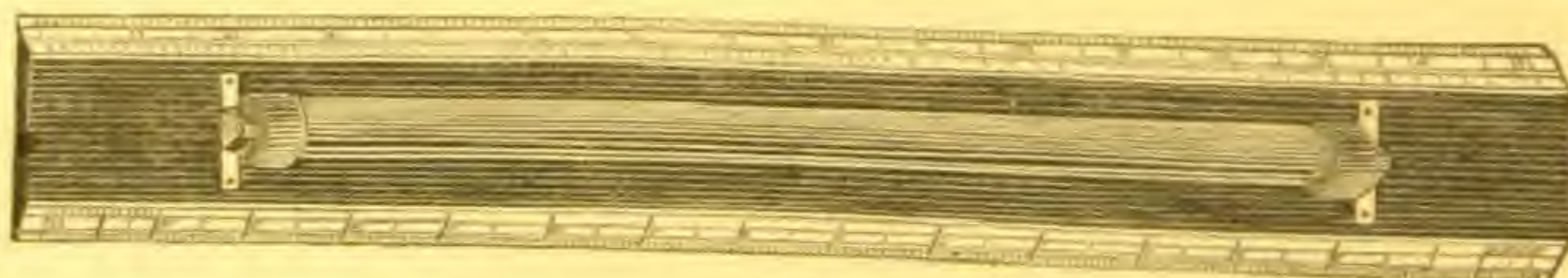
No.							PRICE.
750.	Parallel Rulers, ebony, brass mounted, 6 inches long, each,	.	.	.	.	.	\$0 25
751.	Do. do. do. 9 do. do.	.	.	.	.	.	50
752.	Do. do. do. 12 do. do.	.	.	.	.	.	75
753.	Do. do. do. 15 do. do.	.	.	.	.	.	1 00
754.	Do. do. do. 18 do. do.	.	.	.	.	.	1 25
755.	Do. do. do. 24 do. do.	.	.	.	.	.	2.00
756.	Do. German silver mounted, 12 inches long, each,	.	.	.	.	.	1 25

ROLLING PARALLEL RULERS.



759.

759.	Parallel Ruler, all German silver, on rollers, 12 inches long,	.	.	.	.	.	10.00
760.	Do. do. do. 15 do.	.	.	.	.	.	12.00
761.	Do. do. do. 18 do.	.	.	.	.	.	15.00
762.	Do. all brass, on rollers, 9 inches long,	.	.	.	.	.	6.50
763.	Do. do. do. 12 do.	.	.	.	.	.	8.00
764.	Do. do. do. 15 do.	.	.	.	.	.	10.00
764½.	Do. do. do. 18 do.	.	.	.	.	.	12.00
765.	Do. ebony, do. 12 do.	.	.	.	.	.	3.25
766.	Do. do. do. 15 do.	.	.	.	.	.	4.00
767.	Do. do. do. 18 do.	.	.	.	.	.	5.00



768.

768.	Parallel Ruler, ebony, ivory graduated edges, on rollers, 12 inches long,	.	.	.	.	.	5 00
769.	Do. do. do. do. 15 do.	.	.	.	.	.	6 50
770.	Do. do. do. do. 18 do.	.	.	.	.	.	7 50

No. 800. **WHATMAN'S HOT AND COLD-PRESSED DRAWING PAPERS, SELECTED.** PRICE

			Best.	PER SHEET.
Demy,	20x15 inches,	per quire,	\$1 00	\$0.09
Medium,	22x17 do.	do.	1 50	.12
Royal,	24x19 do.	do.	2 00	.15
Super-royal,	27x19 do.	do.	2 50	.18
Imperial,	30x21 do.	do.	3 50	.25
Atlas,	33x26 do.	do.	5 25	.30
Double Elephant,	40x26 do.	do.	6 00	.40
Antiquarian,	52x31 do.	do.	30 00	2.00

Whatman's papers, hot pressed, have smooth surfaces; cold pressed, have fine grain surfaces. In ordering, customers will please state which surface they desire.

802. **CONTINUOUS DRAWING PAPER, EXTRA WHITE.**

IN ROLLS OF 30 TO 50 POUNDS.

Best German make,	36 inches wide,	thin,	per pound	55 cents,	per yard,	35
Do. do.	42 do.	thick,	do.	55 do.	do.	45
Do. do.	54 do.	thick,	do.	55 do.	do.	50
Do. do.	54 do.	thin,	do.	55 do.	do.	35
Best egg shell,	59 do.	thick,	do.	55 do.	do.	75
Do. do.	59 do.	medium,	do.	55 do.	do.	55
Do. do.	59 do.	thin,	do.	55 do.	do.	45
Do. German make,	62 do.	thick,	do.	55 do.	do.	65

803. **MUSLIN BACKED CONTINUOUS DRAWING PAPER, EXTRA WHITE.**

	36 inches wide,	medium,	per roll,	\$8.50,	per yard,	1.00
	42 do.	do.	do.	9.00,	do.	1.25
Egg Shell,	54 do.	do.	do.	14.00,	do.	1.75
Do.	58 do.	do.	do.	18.00,	do.	2.00
Do.	58 do.	heavy,	do.	19.00,	do.	2.25
	61 do.	extra stout,	do.	18.00,	do.	2.00

Whatman's Drawing Paper, also large sheets for maps, mounted to order.

804. **CONTINUOUS DRAWING PAPER, BUFF TINT, FOR WORKING DRAWINGS.**

BEST ENGLISH MAKE, IN ROLLS OF 50 TO 80 POUNDS.

40 inches wide,	medium thickness,	per pound,	\$0.50,	per yard,	.25
54 do.	do.	do.	50,	do.	.35

BEST AMERICAN MAKE, IN ROLLS OF 70 TO 100 POUNDS.

36 inches wide,	thick,	per pound	\$0.15,	per yard,	.12
42 do.	do.	do.	.15,	do.	.16
48 do.	do.	do.	.15,	do.	.18
54 do.	do.	do.	.15,	do.	.20

Full rolls only of continuous paper sold by the pound at above rates.

804½. **Architects' Manilla Sketching Paper, 31x50, per quire, \$7.50, per sheet.** .40

This paper is an entirely new article, needs no stretching, will not buckle, and is especially recommended.

805. **TRACING OR VELLUM CLOTH.**

In Rolls of 24 yards, both sides glazed, or face glazed and back dull, suitable for pencil marks.

Imperial,	18 inches wide,	per roll	\$6.50,	per yard,	35
Do.	30 do.	do.	9.00,	do.	50
Do.	36 do.	do.	10.00,	do.	60
Do.	42 do.	do.	14.00,	do.	75
Sagar's Patent,	18 do.	do.	7.00,	do.	35
Do.	30 do.	do.	9.50,	do.	50
Do.	36 do.	do.	10.00,	do.	60
Do.	42 do.	do.	14.00,	do.	75

TRACING PAPER.

No.				PRICE
806.	French, in Sheets.	Royal, 19x25 inches,	per quire,	\$1 00
807.	Do. do.	Super-Royal, 21x26 inches,	do.	1 50
808.	Do. do.	Double Elephant, 28x40 inches,	do.	2 50
809.	Do. in Rolls, 11 yards long and 43 inches wide,	per roll,		1 50
810.	Do. do. 22 do. do. do. do.	do.		2 50
811.	Do. Vegetable Royal, 19x25 inches,	per quire, \$2.20,	per sheet,	15
812.	Do. do. Super Royal, 21x26 inches,	do. 3.50,	do.	40
813.	Do. do. Double Elephant, 28x40 do. do.	10.00,	do.	65
814.	Do. do. in rolls of 22 yards, 54 inches wide,	per roll,		5 00
815.	English, in Sheets, 20x30 inches,	per quire,		1 50
815½.	Do. do. 40x30 do.	do.		3 00
816.	Do. finest quality, in sheets, 20x30 inches,	do.		2 63
816½.	Do. do. do. 40x30 do.	do.		5 25
816¾.	Do. in Rolls of 20 yards, 40 inches wide,	per roll,		4 00
817.	German, in Rolls of 20 yards, 43 inches wide,	do.		4.00
818.	Do. do. 33 do. 58 do.	do.		7.50

HUFTY'S DOUBLE-LENGTH PROFILE PAPER.

820. Plate A.—Rulings 42 inches long by 15 inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, twenty to the inch, and having every tenth horizontal division line and every fiftieth vertical division line heavier than the others. Price, per sheet, 40c., per quire, \$8 50
821. Plate A.—Rulings 42 inches long by 6½ inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, twenty to the inch, and having every tenth horizontal division line and every fiftieth vertical division line heavier than the others. Price, per sheet, 30c., per quire, 6 50
822. Plate B.—Rulings 42 inches long by 13 inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, thirty to the inch, and having every fourth horizontal division line and every twenty-fifth vertical division line heavier than the others. Price, per sheet, 40c., per quire, 8 50
823. Plate B.—Rulings 42 inches long by 6½ inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, thirty to the inch, and having every fourth horizontal division line and every twenty-fifth vertical division line heavier than the others. Price, per sheet, 30c., per quire, 6 50
824. Plate C.—Horizontal Divisions, five to the inch; Vertical Divisions, twenty-five to the inch, and having every fifth horizontal division line and every twenty-fifth vertical division line heavier than the others. Price, per sheet, 40c., per quire, 8 50

CONTINUOUS OR ROLL PROFILE PAPER.

After a long series of experiments, we are now prepared to supply a perfect article of *Profile Paper* in continuous rolls of any length, (22 inches wide), and of the following scales:

825. Plate A.—Rulings 20 inches wide, Horizontal Divisions four to the inch; Vertical Divisions, twenty to the inch, and having every tenth horizontal division line and every fiftieth vertical division line heavier than the others. Price, per yard, 30
826. Plate B.—Rulings 20 inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, thirty to the inch, and having every fourth horizontal division line and every twenty-fifth vertical division line heavier than the others. Price, per yard, 30
827. Plate B.—Rulings 9 inches wide, Horizontal Divisions, four to the inch; Vertical Divisions, thirty to the inch, and having every fourth horizontal division line and every twenty-fifth vertical division line heavier than the others. Price, per yard, 20

MUSLIN BACKED ROLL PROFILE PAPER.

No.		PRICE.
828.	Muslin Backed Roll Profile Paper, of either Plate A or B, 20 inches wide, in rolls of 20 yards, per yard,	\$0 75
829.	Muslin Backed Roll Profile Paper, Plate B, 9 inches wide, in rolls of 20 yards, per yard,	50
<i>Plate B corresponds to that in sheets known as Brown's Profile Paper.</i>		

CROSS SECTION PAPERS.

830.	Topographical Paper, 14x17 inches, ruled 400 feet to the inch, per sheet, 12 cents,	
831.	Trantwine's Cross Section and Diagram, 10 feet to inch, for embankments of 14 and 24 feet, roadway, and for excavations of 18 and 28 feet, rulings 19 $\frac{3}{4}$ x12 inches, per sheet, 25c.,	per quire, 1 75
832.	Cross Section Papers, rulings 22x16 inches, 8 feet to inch, per sheet, 25c.,	per quire, 5 00
833.	Do. do. do. 20x16 do. 10 do. do. 25c.,	5 00
834.	Do. do. do. 20x16 do. 10 do. do. 25c.,	5 00
	heavy, per sheet 25c., per quire,	5 00
835.	Cross Section Papers, rulings 21x16 inches, 16 feet to inch, per sheet, 25c.,	5 00
<i>All the Profile and Cross Section Papers can be furnished, printed with red or green lines.</i>		
836.	Design Papers for Weavers, rulings 8x7 to block, 40x40 blocks, per quire,	3.00
837.	Do. do. do. 8x8 do. 34x40 do. do.	3.00
838.	Do. do. do. 8x16 do. 30x35 do. do.	3.00
839.	Patent Office Blanks (Bristol Board), per sheet, 10 cts., per dozen,	1.00

LYONS' TABLES.


840. Lyons' Tables. A set of Tables for finding at a glance the true cubical contents of Excavation and Embankments for all Bases, and for every variety of Ground and Side Slopes. By M. E. LYONS, C. E.

Sheet No. 1. General Table for all Bases and all Slopes.

Do.	2.	For Side Hill Cuts and Fills.	
Do.	3.	Base 12 feet Slopes,	$1\frac{1}{2}$ to 1
Do.	4.	do. 14 do.	$1\frac{1}{2}$ to 1
Do.	5.	do. 15 do.	$1\frac{1}{4}$ to 1
Do.	6.	do. 15 do.	1 to 1
Do.	7.	do. 15 do.	$1\frac{1}{2}$ to 1
Do.	8.	do. 16 do.	$1\frac{1}{4}$ to 1
Do.	9.	do. 16 do.	1 to 1
Do.	10.	do. 18 do.	$\frac{1}{4}$ to 1
Do.	11.	do. 18 do.	$\frac{3}{4}$ to 1
Do.	12.	do. 18 do.	1 to 1
Do.	13.	do. 18 do.	$1\frac{1}{2}$ to 1
Do.	14.	do. 20 do.	$1\frac{1}{2}$ to 1
Do.	15.	do. 24 do.	$1\frac{1}{4}$ to 1
Do.	16.	do. 24 do.	$1\frac{1}{2}$ to 1
Do.	17.	do. 25 do.	$1\frac{1}{2}$ to 1
Do.	18.	do. 26 do.	$1\frac{1}{2}$ to 1
Do.	19.	do. 28 do.	$1\frac{1}{4}$ to 1
Do.	20.	do. 30 do.	1 to 1
Do.	21.	do. 30 do.	$1\frac{1}{4}$ to 1
Do.	22.	do. 30 do.	$1\frac{1}{2}$ to 1
Do.	23.	do. 32 do.	1 to 1
Do.	24.	do. 32 do.	$1\frac{1}{2}$ to 1

The Tables are printed in clear, bold type on tinted paper, sheets 25x16 inches. They may be used by candle-light without injuring the eyesight. Each sheet is complete in itself, and embraces all that is wanted in connection with the Base or Slope designated, whether on level or side-hill cross section.

Per sheet, 25 cents; bound in one volume, \$8 50

 A sample book of all our papers from 800 to 835 sent on application.

840 $\frac{1}{2}$. Table for reducing perches to feet, also decimal parts of a foot for each inch and sixteenth of an inch, per sheet, .25

FIELD BOOKS.

No.		PRICE.
841.	Level Book, 7x4 inches, made of superior drawing paper, per dozen,	\$6 00
842.	Do. 6½x4 do. extra smooth paper, do.	4 50
842½.	Profile Level Books, 7x4 inches, made of superior drawing paper, do.	7 50
843.	Transit Books, 7x4 inches, made of superior drawing paper, do.	6 00
844.	Do. 6½x4 do. extra smooth paper, do.	4 50
845.	Record, 7½x5 inches, made of superior writing paper, do.	9 00
846.	Cross Section Books, 8 inches long by 7 wide, for Topography, do.	12 00

BOUND PROFILE BOOKS.

These books are for field or office purposes, being printed on both sides, of a tough thick paper, and bound in flexible covers convenient for the pocket. Each page will contain a profile of three thousand feet in length, so that each folio will contain an average section of a road as usually laid out for construction. Railroad and other engineers will find them very useful. Size of book 9½ by 5½ inches. The rulings correspond to our large profile plates A and B.

847.	Plate A, 25 leaves imitation Turkey morocco, with elastic band,	3 50
	Do. 50 do. do. do. do.	5 00
	Do. 100 do. do. do. do.	8 00
	Do. 50 do. Turkey morocco, turned edges, with elastic band,	6 00
	Do. 100 do. do. do. do.	9 00
848.	Plate B, 25 do. imitation Turkey morocco, with elastic band,	3 50
	Do. 50 do. do. do. do.	5 00
	Do. 100 do. do. do. do.	8 00
	Do. 50 do. Turkey morocco, turned edges, with elastic band,	6 00
	Do. 100 do. do. do. do.	9 00



849.

849.	Patent Ink Slab, with cover, 1½x4½ inches, each,	.50
850.	Do. do. do. 2½x5½ do.	.60

INK SLABS AND SAUCERS.



855.



859.

PORCELAIN SLABS.

For India Ink and Colors. Containing 3 holes or cups and 1 slanting division.

855.	Measuring 2½ by 1½ inches,	each,	15
856.	Do. 3½ by 2½ do.	do.	25
857.	Do. 4½ by 2½ do.	do.	35
858.	Do. 4½ by 3 do.	do.	40

CABINET NESTS.

Porcelain Saucers in Nests: fitted on each other.

859.	Containing 5 Saucers and a Cover, 2½ inches in diameter, per nest,	\$0.60
860.	Do. 5 do. do. 2½ do. do. do.	.70
861.	Do. 5 do. do. 3½ do. do. do.	.80
861½.	Do. 5 do. do. 3½ do. do. do.	1.00
861¾.	Architect's Basin, with 8 divisions and cup,	1.35

WINSOR & NEWTON'S WATER COLORS. HARD COLORS IN CAKES, OR MOIST IN CHINA PANS.



Whole Cake.

862

Half Cake.

862. Whole cakes or pan, 30 cents each; half cakes or pan, 15 cents each.

Antwerp Blue,
Bistre,
Blue Black,
British Ink,
Brown Ochre,
Brown Pink,
Bronze,
Burnt Sienna,
Burnt Umber,
Chinese White,
Chrome Yellow,
Cologne Earth,
Deep Chrome,
Dragon's Blood,
Emerald Green,

Flake White,
Gamboge,
Hooker's Green, No. 1,
Hooker's Green, No. 2,
Indigo,
Indian Red,
Italian Pink,
Ivory Black,
King's Yellow,
Lamp Black,
Light Red,
Naples Yellow,
Neutral Tint,
New Blue,
Olive Green,
Orange Chrome,

Payne's Grey,
Prussian Blue,
Prussian Green,
Raw Sienna,
Raw Umber,
Red Chalk,
Red Lead,
Red Ochre,
Roman Ochre,
Sap Green,
Terre Verte,
Vandyke Brown,
Venetian Red,
Vermilion,
Yellow Lake,
Yellow Ochre.

863. Whole cakes or pan, 60 cents each; half cakes or pan, 30 cents each.

Black Lead,
Brown Madder,
Chalon's Brown,
Constant White,
Crimson Lake,

Indian Yellow,
Mars Yellow,
Neutral Orange,
Purple Lake,
Roman Sepia,

Reuben's Madder,
Scarlet Lake,
Scarlet Vermilion,
Sepia,
Warm Sepia.

864. Whole cakes or pan, 85 cents each; half cakes or pan, 45 cents each.

Cobalt Blue,

Orange Vermilion,

Violet Carmine.

865. Whole cakes or pan, \$1.15 each; half cakes or pan, 60 cents each.

Aureolin,
Burnt Carmine,
Cadmium Yellow,
Cadmium Orange,
Carmine,

French Blue,
Gallstone,
Green Oxide of Chromium,
Indian Purple,
Intense Blue,
Lemon Yellow,

Pale Cadmium Yellow,
Pink Madder,
Pure Scarlet,
Rose Madder,
Viridian.

866. Whole cakes or pan, \$1.80 each; half cakes or pan, 90 cents each.

Field's Orange Vermilion,
Madder Carmine,

Mars Orange,
Purple Madder,

Smalt,
Ultramarine Ash.

Color Boxes furnished to order, to hold 6, 12, 18, or 24 whole or half cakes.

Prices, 50 cents, 75 cents, \$1.00 and \$1.50 each.

WINSOR & NEWTON'S WATER COLOR LIQUIDS.

In Glass Bottles.

866 $\frac{1}{2}$. Carmine,	60 cents.	867 $\frac{3}{4}$. Extract of Ox Gall,	50 cents
866 $\frac{3}{4}$. Indelible Brown Ink,	60	868. Indian Ink,	50
867. Prout's Brown,	60	868 $\frac{1}{2}$. Chinese White,	50
867 $\frac{1}{2}$. Gold Ink,	50	868 $\frac{3}{4}$. Pure Gold in shells,	20

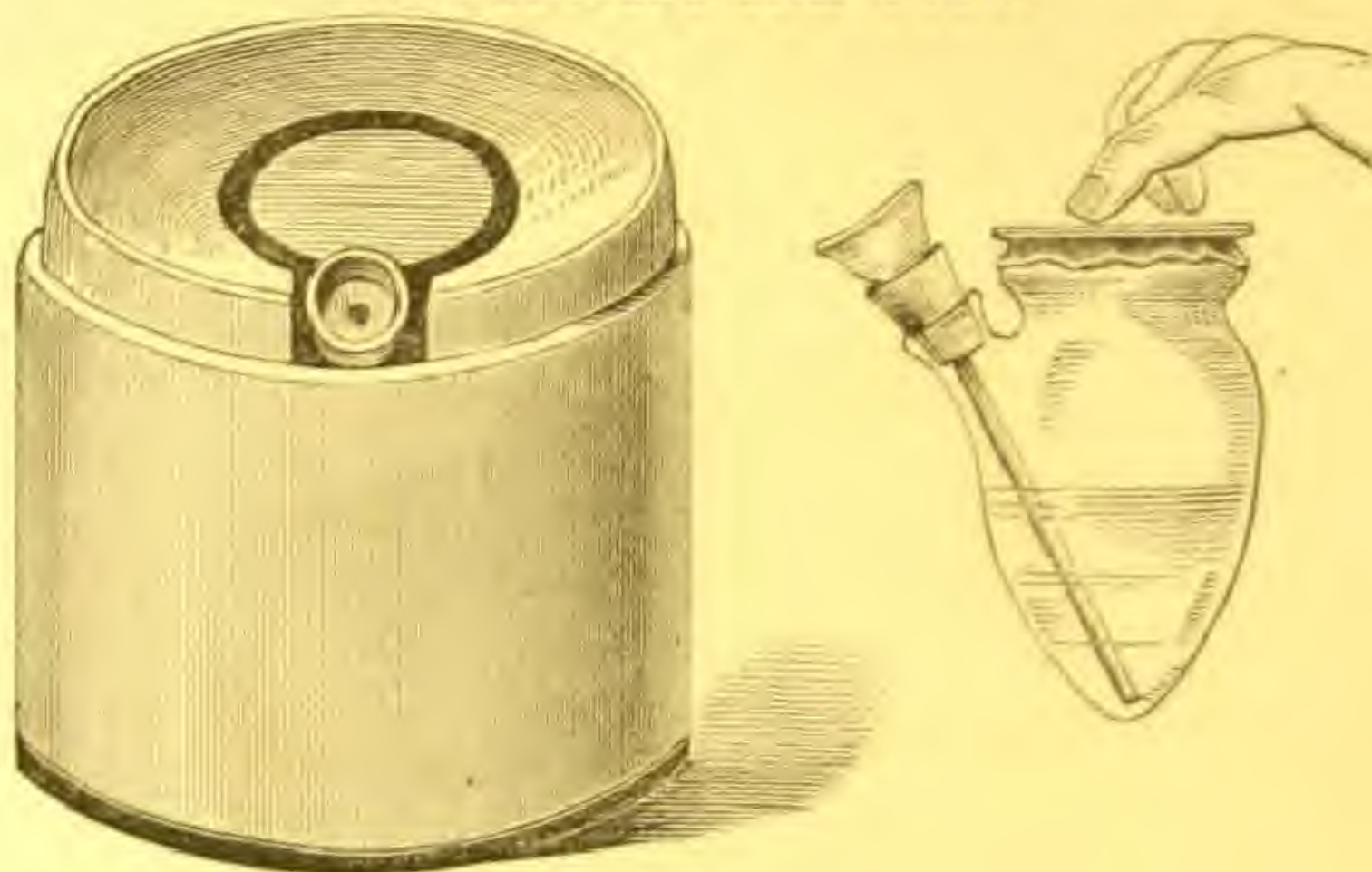
Pure Gold in cakes, \$2.50; in cups, 25 cents.

QUEEN'S LIQUID INDIAN INK.

This ink is specially recommended, working up easily and smoothly, and leaving a beautiful, well-marked, and permanent impression.

No.		PRICE.
869.	In one ounce glass bottles.	\$0.50

AUTOMATIC INK CUPS.



869½.

869½	Single bottle, in box, with lid,	.75
	Triple do. do.	1.25

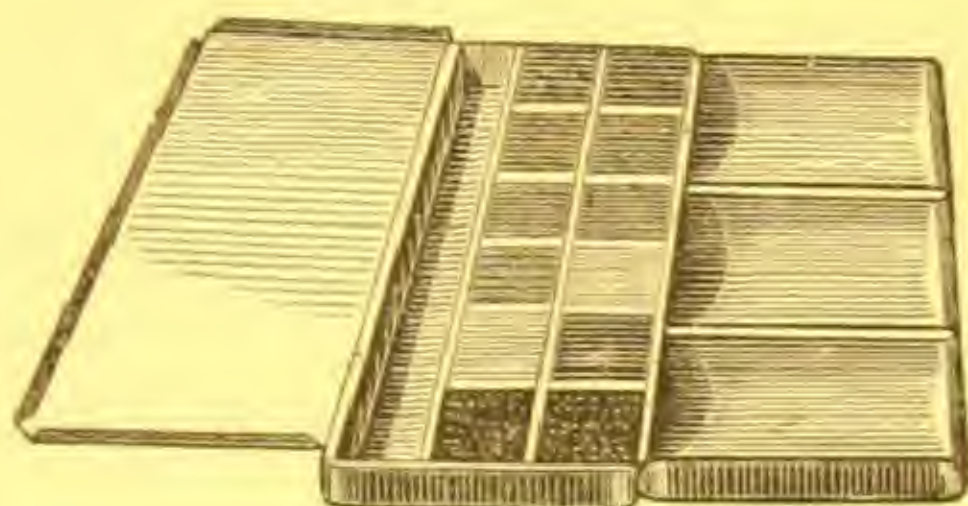
These Cups are intended to hold Water Colors or India Ink in a liquid state. The cup being hermetically sealed, there is no evaporation. The ink is always ready, and can be used up entirely. After grinding or dissolving a sufficient quantity to about half fill the cup, the ink is placed in by removing the small tube. Replace tube, and by a slight pressure of the finger on the rubber top the color is forced up into the mouthpiece and the pen or brush filled. On removing the pressure, the contents return to the cup. It saves the waste of color caused by drying or scaling, and the time consumed in mixing whenever ink is needed.

WINSOR & NEWTON'S CABINET SETS.



870.

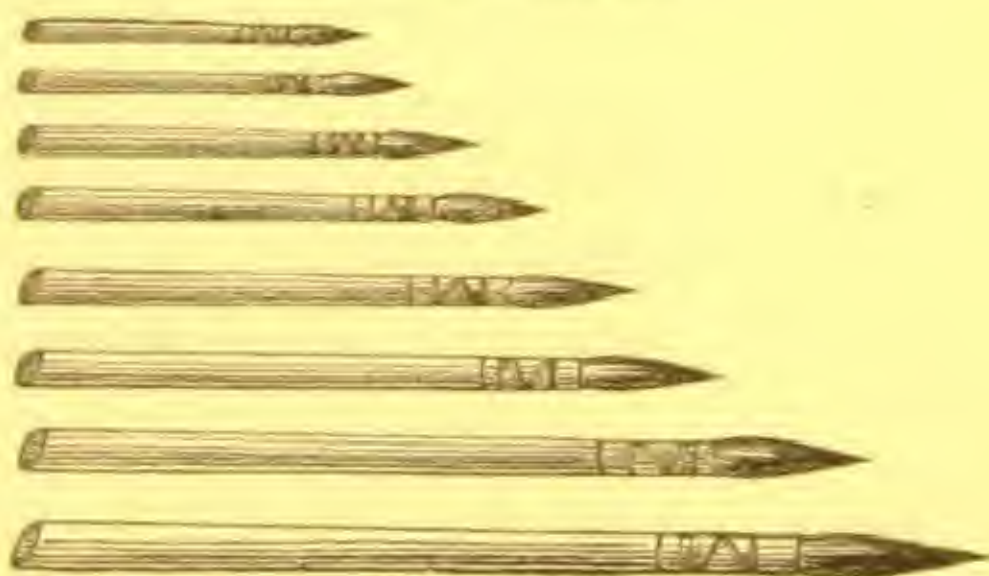
No.									Whole cakes.	Price. Half cakes.
870.	Polished Mahogany Box, with lock and key, and drawer, paint									
	stone, water glass, India ink, brushes, and 12 colors,								\$12.00	
871.	Do.	do.	do.	do.	do.	18	do.		16.00	\$12.00
872.	Do.	do.	do.	do.	do.	24	do.		20.00	15.00
873.	Polished Mahogany Box, with sliding lid and 12								5.00	3.00
874.	Do.	do.	do.	do.	do.	18	do.		7.50	4.25
875.	Empty Mahogany Color Boxes, for 12 colors,								.60	.50
	Do.	do.	do.	do.	18	do.			.75	.60
	Do.	do.	do.	do.	24	do.			1.00	.75



876.

876.	Empty Japanned Tin Boxes for Moist Colors in Pans.									
	For 6 full or 12 half pans, each,									1.50
	For 12 do. 24 do. do.									2.25
	For 16 do. 32 do. do.									2.50
	For 24 do. 48 do. do.									3.00

BRUSHES.



877.

877.	Camel Hair Pencils, fine quality, 2 inches long, each,									.05
	Do.	do.	do.	2½	do.	do.				.06
	Do.	do.	do.	3	do.	do.				.08

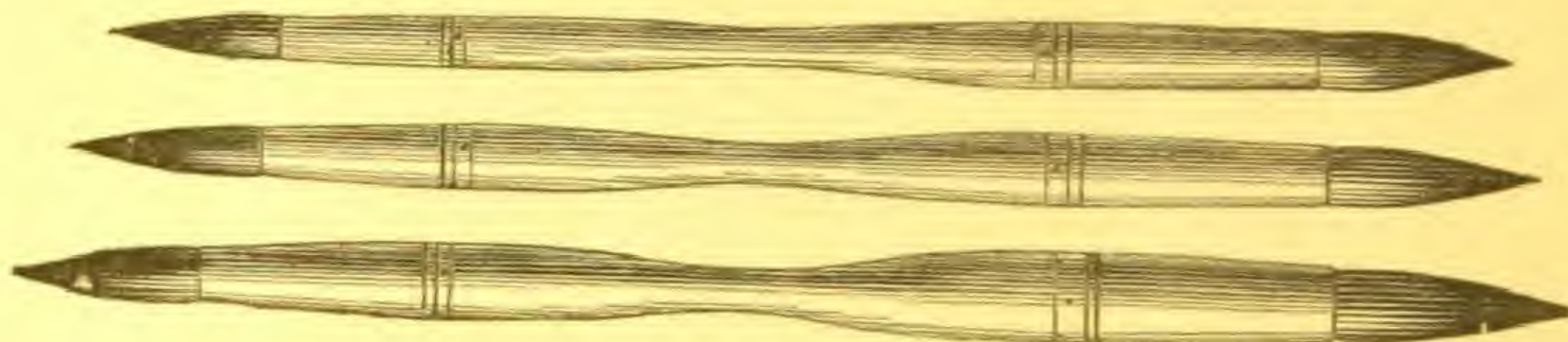


878

No.

PRICE.

878. Camel Hair Pencils, fine quality, wood handles, and metal tubes,
Nos. 1 and 2, 10 cents each; 3 and 4, 12 cents; 5 and 6, 15 cents.



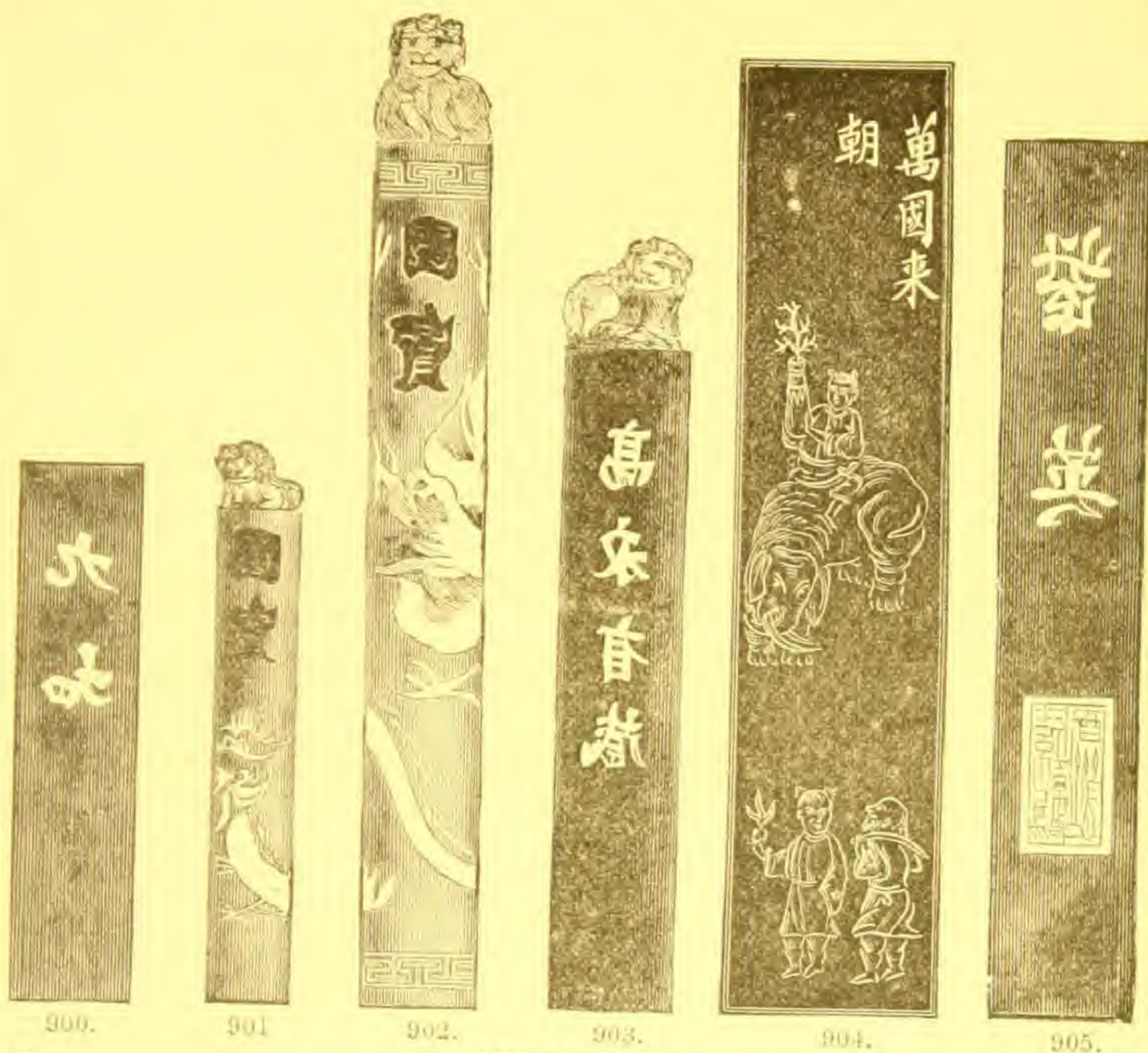
879.

879. Double Camel Hair Wash Pencils, fine quality, metal tubes, wood handles,
Nos. 0, 40 cents each; 1, 50 cents; 2, 60 cents; 3, 75 cents.
879½. Single Camel Hair Wash Pencils, same quality and sizes as No. 879,
Nos. 0, 20 cents each; 1, 30 cents; 2, 35 cents; 3, 45 cents.



880.

880. Large Camel Hair Pencils, in swan quill, fine quality,
Nos. 0 and 1, 60 cents each; 2 and 3, 40 cents; 4, 5 and 6, 25 cents.
881. Red Sable Hair Pencils, 1½ inch to 2 inches long, each,
Do. do. 2 do. 2½ do. do. . 15 & 25
Do. do. 2½ do. 3½ do. do. . 30
882. Red Sable Hair Pencils, with black wood handles,
Nos. 1 and 2, 25 cents each; 3 and 4, 40 cents; 5 and 6, 70 cents.
882½. Large Red Sable Hair Pencils, in swan quill, fine quality,
Nos. 0, \$2.50 each; 1, \$2.25; 2, \$2.00; 3, \$1.50; 4, \$1.00; 5, 75 cents.
883. Brown Sable Hair Pencils, with black wood handles,
Nos. 1 and 2, 30 cents each; 3 and 4, 45 cents; 5 and 6, 80 cents.
883½. Large Brown Sable Hair Pencils, in swan quill, fine quality,
Nos. 0, \$3.00 each; 1, \$2.50; 2, \$2.00; 3, \$1.50; 4, \$1.00.



No.	INDIA INK.	PRICE
900.	India Ink, Sticks, four-sided black, gilt, 2 inches long, each,	\$0 10
901.	Do. round, lion's head, gilt, 2½ inches long, each,	25
902.	Do. do. 4 inches long, each,	75
903.	Do. oval, lion's head, 3 inches long, each,	40
904.	Do. very superior, sticks 3¼ by ¾ by ¾ inches, each,	1 50
904½.	Do. same quality as No. 904, sticks 3¼ by ¾ by ¾ inches, each,	75
905.	India Ink, Windsor & Newton's best, Sticks square, 3½ inches long, each,	2 00
	A. India Blue (Ultramarine),	.75
	B. India Reddish Brown (Bt. Sienna),	.75
	C. India Yellow (Chrome),	.75
	D. India Red (Vermilion),	1.00
	E. India Lake (Crimson),	1.25

INDIA RUBBER.

906.	A. W. Faber's, First Quality, White; pieces 1½ by ¾ inches, each,	05
907.	Do. do. do. 1½ by 1 do.	06
908.	Do. do. do. 1½ by 1½ do.	12
909.	Do. do. do. 2 by 1½ do.	20
910.	Do. do. Black, pure gum, 2 by 1½ do.	20
911.	Do. do. do. 2½ by 1½ do.	35
912.	Do. Combined Ink and Pencil Erasers, each,	20
912½.	Do. do. do. mammoth, each,	30
912¾.	A. Sponge Rubber, for cleaning paper, pieces 1 by 1 by ¾ inches, each,	10
	B. do. do. do. 2½ by 1½ by ¾ do.	35
	C. do. do. do. 4 by 2 by 1 do.	75

LEAD PENCILS.

No.	LEAD PENCILS.	PRICE.
913.	A. W. Faber's Hexagonal, gilt, Nos. 1, 2, 3, 4, 5, per dozen,	\$1.00
914.	Do. Pure Siberian Lead, Nos. BBBBBB, BBB, BB, B, HB, F, H, HH, HHH, HHHHHH; very superior, 20 cts. each, per dozen,	1.50
914½.	American Lead Pencils, Grade S, SM, M, H, VH, for general drawing, per dozen,	.60
915.	A. W. Faber's small, round, for Divider Points, per dozen,	.75
916.	J. W. Queen's Hexagonal, Nos. 1, 2, 3, 4, per dozen,	\$.60
917.	Red, Green, Blue and Yellow Pencils, per dozen,	1 50
918.	J. W. Guttknecht's Pencils, Red at one end, Blue at the other, per dozen,	1 50
919.	Faber's Artist's Pencil, hexagon, gilt, each,	\$0 25
919½.	Leads for do., 6 in a box, Nos. 1, 2, 3, 4, 5, per box,	50
920.	Faber's Artist's Pencil, with Siberian Lead,	35
920½.	Leads for do., 6 in a box, Nos. 4B to 6H, per box,	85

The leads of Nos. 919½ and 920½ will fit the new pencil-holders in Alteneder and Swiss sets, No. 284, &c. Each box has only one grade of leads.

MISCELLANEOUS.

921.	Mouth Glue, per piece,	.	.	.	.	.	.	.	.	05
922.	Gillott's Mapping Pens, per dozen,	.	.	.	.	.	.	.	.	75
923.	Do.	do.	on cards, with holder, per dozen,	.	.	.	.	.	.	75
924.	Do.	Lithographic Crow Quill Pens, on card, with holder, per dozen,	.	.	.	.	.	.	.	75



925.

925.	Rogers & Son's Steel Blade Eraser, cocoa handles, each,	60
926.	Do. do. do. ivory handles,	75
	Gillott's extra fine Steel Pens, No. 303, per gross \$1.50, per dozen,	25
	"Falcon," "Commercial," and "Business" Pens, per gross,	75
	Best Foolscap Paper, per ream \$6.50, per quire,	35
	Do. Letter do. do. 5.25, do.	30
	Do. Commercial Note, do. 3.35, do.	20
	Superior Post Office Paper, buff tint, per ream 9.75, per quire,	55
	Printed Legal Cap Paper, specially ruled for specifications and contracts, per ream 10.50, per quire,	60
	Flat Paper, smooth, extra, 16x21, per ream,	9 50
	Do. do. do. 18x23, do.	13 50
	Superior White Envelopes, per thousand 5.25, per package,	25
	Do. Buff do. do. 4.25, do.	15
	Do. do. do. "legal," (large size) per thousand 8.75, package,	30
	Arnold's Writing Fluid, per quart,	87
	Blue Ink, per bottle,	25
	David's Carmine, 2 ounce bottles, with glass stoppers, per bottle,	50
	Rubber Bands, $\frac{1}{4}$ inch wide, 2 inches long, per gross 1.15, per dozen,	12
	Do. $\frac{1}{4}$ do. $2\frac{1}{2}$ do. do. 1.40, do.	15
	Do. $\frac{1}{4}$ do. 3 do. do. 1.55, do.	20
	Do. $\frac{1}{4}$ do. $3\frac{1}{2}$ do. do. 2.00, do.	25
	Do. $\frac{1}{2}$ do. 2 do. do. 2.25, do.	25
	Do. $\frac{1}{2}$ do. $2\frac{1}{2}$ do. do. 2.50, do.	30
	Do. $\frac{1}{2}$ do. 3 do. do. 2.75, do.	35
	Do. $\frac{1}{2}$ do. $3\frac{1}{2}$ do. do. 3.00, do.	40
	Do. $\frac{1}{2}$ do. assorted length, do. 2.00.	
	Do. $\frac{1}{8}$ do. $1\frac{1}{4}$ inches long for tickets, &c., per gross,	25
	All other sizes Rubber Bands furnished at proportional rates.	

All other sizes Rubber Bands furnished at proportional rates.

	PRICE.
Mucilage, per quart, \$1.25, per cone (3 oz.),	\$0.25
Red Chalk Pencils for Marking Stakes, per dozen,	1.25
Red Crayons, superior quality, per dozen,	.60
Red Chalk, in lumps, per pound,	.30
Arkansas Oil Stones,	.25 to 2.00

Copying Books, Copying Ink and Presses, Blotting Paper, and all articles of Stationery needed in Engineers' offices, furnished at reasonable rates.

Envelopes, Letter and Note Heads, Cards, &c., printed and lithographed at usual prices.

REYNOLD'S BRISTOL BOARD.

	per dozen,	2 sheets.	3 sheets.	4 sheets.
12 $\frac{3}{4}$ x16 $\frac{1}{4}$ inches, Cap,		\$0.70	\$1.10	\$1.40
14 $\frac{1}{2}$ x18 $\frac{1}{2}$ do. Demy,	do.	1.10	1.50	1.80
16 $\frac{1}{2}$ x20 $\frac{3}{4}$ do. Medium,	do.	1.40	1.80	2.50
18 x22 $\frac{1}{2}$ do. Royal,	do.	2.00	2.75	3.50

Bondpaper, for tracings, very tough.

	16 x 21	16 x 24	19 x 24	19 x 30 inches.
per 100 sheets,	\$3.25	3.75	4.00	5.00

English Parchment.

	16 x 20	18 x 20	18 x 22	18 x 24	20 x 24 inches.
per dozen,	\$5.25	6.00	7.00	7.25	7.50

	13 x 19	17 x 21 inches.
Gelatine or Glasspaper,		
per dozen,	\$3.50	4.00

Transfer Paper, blue, red, and black, 18 $\frac{1}{2}$ x23 inches, Royal, per quire,	2.50
White Mounting Board, 22x28 inches, according to thickness, per sheet,	.15 to .25

CHARCOAL.

BEST QUALITY, IN PASTEBOARD BOXES.

	per box,	
French, in bundles of 50 sticks,	.20	
Venetian, thin, in bundles of 50 sticks,	.40	
French, $\frac{3}{8}$ inch thick, 8 inches long, in bundles of 50 sticks,	.50	
French, $\frac{1}{2}$ do. 8 do. do. do.	.80	

CRAYONS.

No. 1, HARD; No. 2, MEDIUM SOFT; No. 3, VERY SOFT.

	per gross,	
Conté, square, black, Nos. 1, 2, 3,	1.80	
Do. do. red,	1.80	
Do. round, black, 1, 2, 3,	3.60	
Do. do. varnished,	5.00	
Do. sauce, Velvet black, wrapped in foil,	9.00	
German, round, black, 6 inches long, fine,	12.00	
25 Crayons, assorted colors, in box, each,	1.25	
50 do. do. do. do.	2.50	
100 do. do. do. do.	5.00	
Crayon Holders,	.10 to .50	

SOLID SKETCH BLOCKS.

Each Block consists of 32 leaves of best quality Whatman's Drawing Paper.

					PRICE.
16mo Royal,	4½ x 6,	.	.	unbound, \$0.65	*bound, \$1.25
8vo do.	6 x 9,	.	.	do. 1.00	do. 1.85
4to do.	9 x 12,	.	.	do. 1.75	do. 3.00
Half do.	12 x 18,	.	.	do. 3.00	do. 4.50
32mo Imperial,	3½ x 5½,	.	.	do. .55	do. 1.00
16mo do.	5½ x 7,	.	.	do. .80	do. 1.50
8vo do.	7 x 10,	.	.	do. 1.40	do. 2.50
4to do.	10 x 14,	.	.	do. 2.50	do. 3.75
Half do.	14 x 20,	.	.	do. 4.25	do. 6.00

* The binding has Cloth Sides and Leather Back, with a Portfolio and Loop for Pencil inside. The Portfolio will last for a number of blocks.

INDUSTRIAL DRAWING COPIES

For Mechanics and Students in Industrial Evening Schools. Prepared, under the superintendence of Prof. Walter Smith, by James E. Stone.

24 large Folio Plates, as below, unmounted, per set,	6.00
do. do. do. mounted, do.	15.00

ISOMETRIC PROJECTIONS.

PLATE 1. Angular Bodies, mounted on pasteboard,	.75
Do. 2. Curved Surfaces and Bodies,	.75

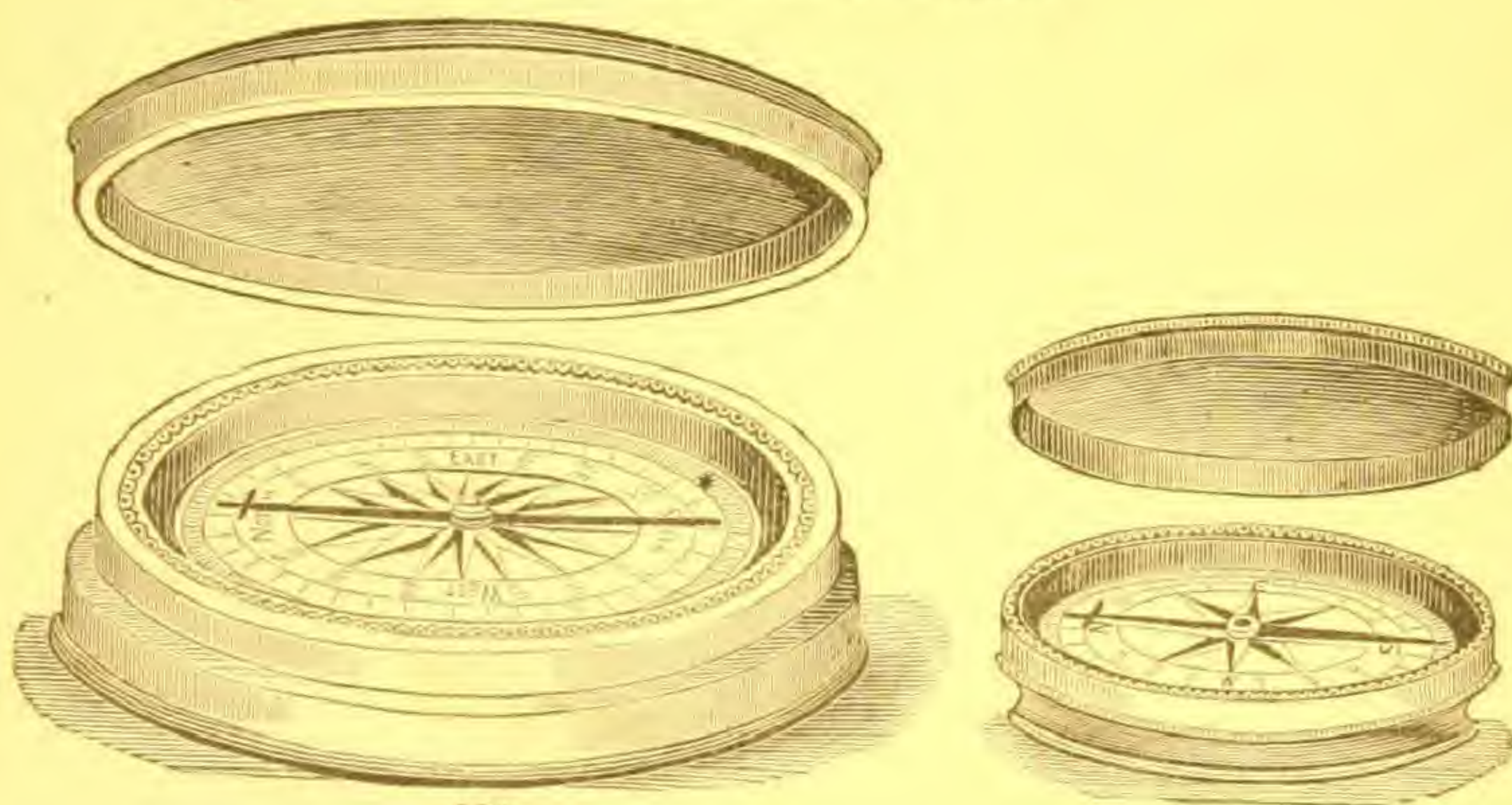
CARPENTRY.

PLATE 1. Framing,	.75
Do. 2. Framing for Front and Side Elevation,	.75
Do. 3. Framing,	.75
Do. 4. Details of Framing,	.75
Do. 5. Details of Framing,	.75
Do. 6. Details of Roof,	.75
Do. 7. Details of a Door,	.75
Do. 8. Joints,	.75

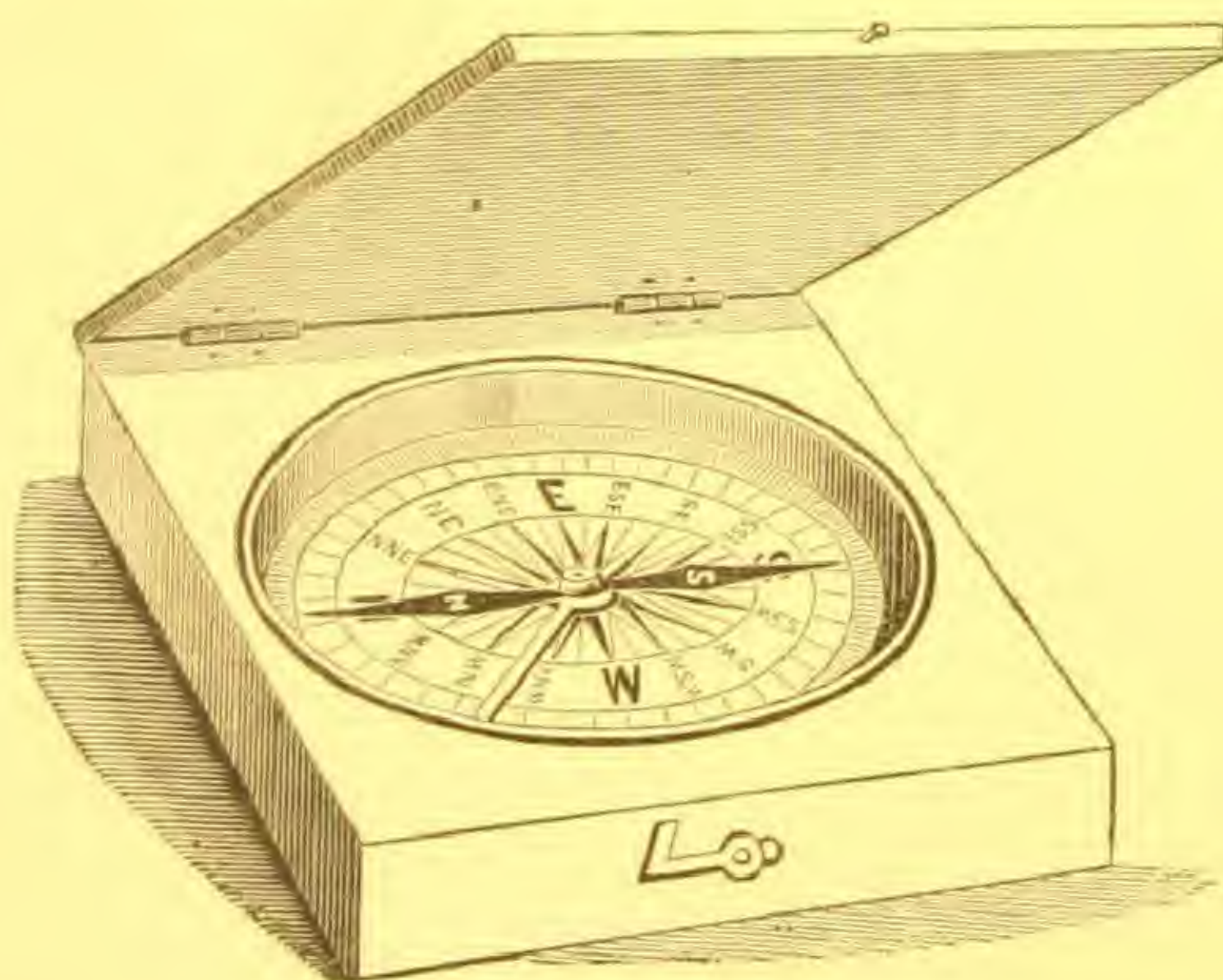
MACHINERY.

PLATE 1. Screws, Bolts, and Nuts,	.75
Do. 2. Theory of Screws and Tops of Bolt-Heads,	.75
Do. 3. Stub End,	.75
Do. 4. Pillow-Block,	.75
Do. 5. Eccentric and Shaft and Eccentric Strap,	.75
Do. 6. Wrench,	.75
Do. 7. Vise,	.75
Do. 8. Faucet and Hand Punch,	.75
Do. 9. Spur Gear,	.75
Do. 10. Approximate Method of Drawing Spur Gear,	.75
Do. 11. Bevel Gear,	.75
Do. 12. Plan of a Steam-Engine,	.75
Do. 13. Elevation of Steam-Engine,	.75
Do. 14. Details of Steam-Engine,	.75
Price per plate, unmounted,	.35

CHAPTER XI.
POCKET COMPASSES.

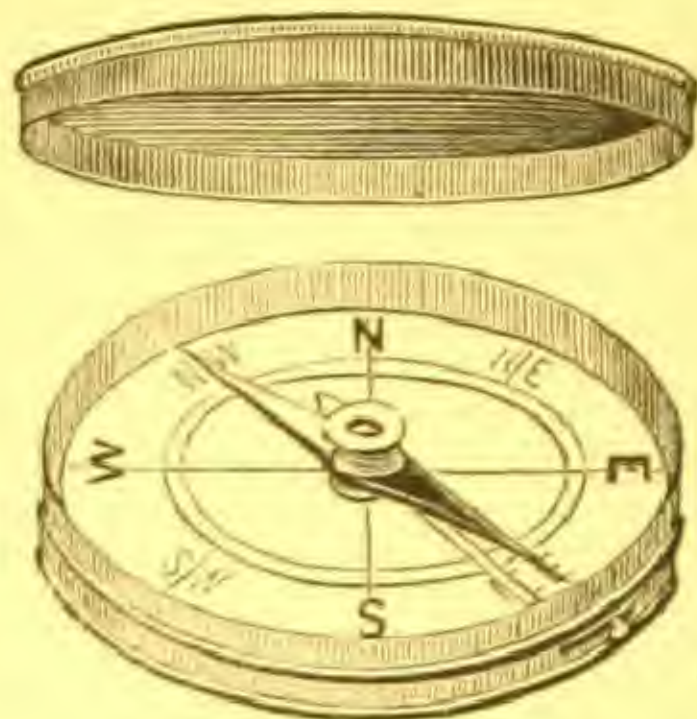


930.



933.

No.							PRICE.
930.	Pocket Compass,	round red wood case,	no stop to needle,	each,			\$0 50
931.	Do.	square do.	do.	do.	do.		50
932.	Pocket Compass,	of Brass, round, $1\frac{1}{2}$ inches diameter,	with cover, no stop to needle,	each,			50
933.	Pocket Compass,	mahogany case, $1\frac{1}{2}$ in. square,	with stop to needle,	each,			1 50
934.	Do.	do.	2 do.	do.	do.	do.	2 00
935.	Do.	do.	$2\frac{1}{2}$ do.	do.	do.	do.	2 25
936.	Do.	do.	3 do.	do.	do.	do.	2 75

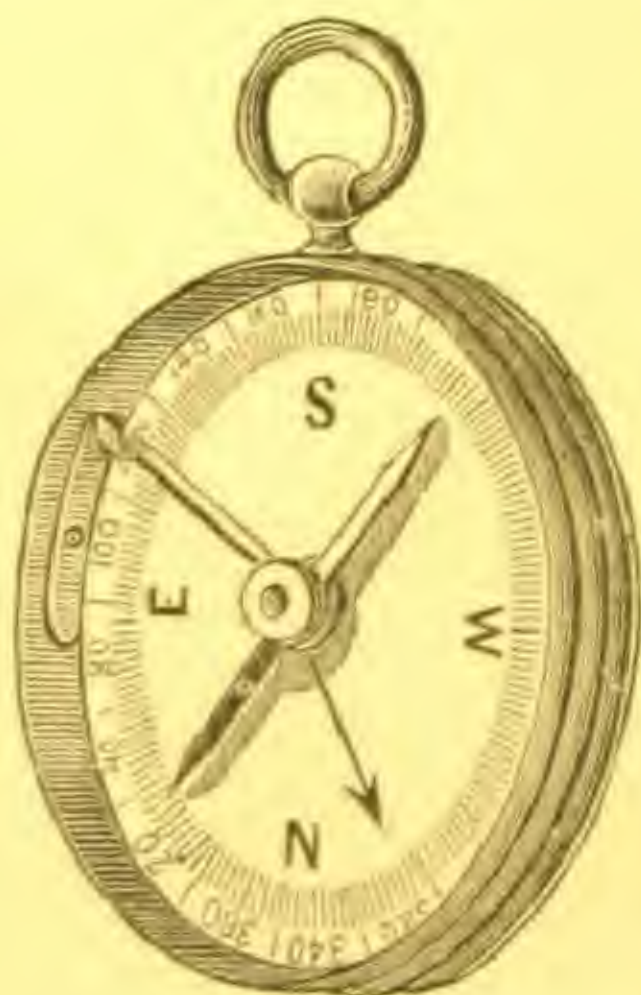


937.

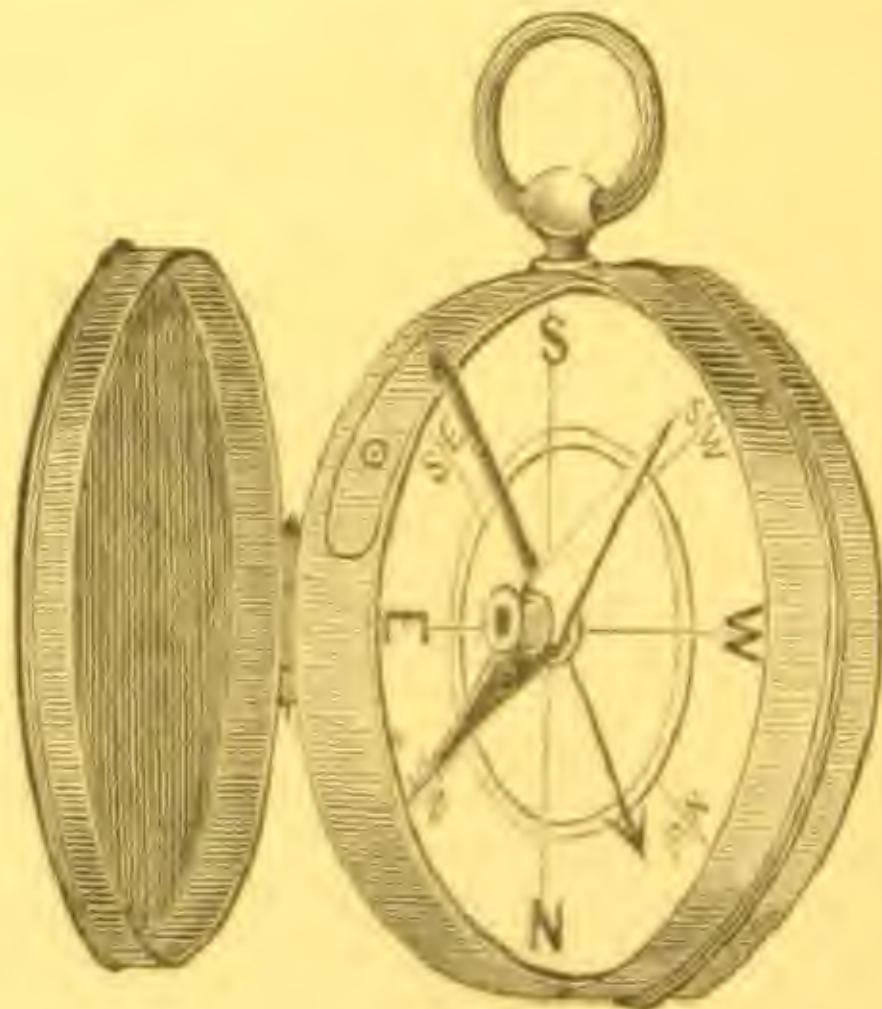


939.

937.	Pocket Compass,	brass round, with cover, $1\frac{1}{2}$ inches diameter,	with stop to needle,				1.25
938.	Do.	brass round, with cover, $1\frac{1}{2}$ inches diameter,	with stop and agate centre to needle,				1.75
939.	Do.	watch pattern, brass, 1 in. diameter,	no stop to needle,				.50
940.	Do.	do.	do. $1\frac{1}{2}$ do.	do.	do.	do.	.65
941.	Do.	do.	do. 1 do.	do.	with stop	do.	.65
942.	Do.	do.	do. $1\frac{1}{2}$ do.	do.	do.	do.	.90



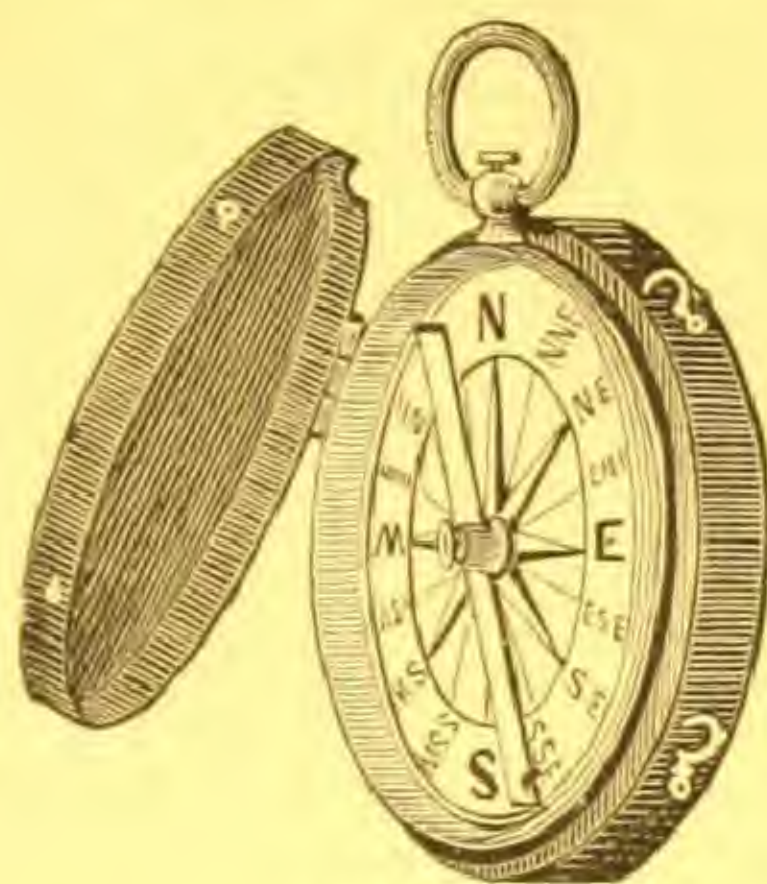
943.



945.

943.	Pocket Compass,	of brass, round, $1\frac{1}{2}$ in. diameter,	with stop and agate centre to needle,				1.25
944.	Do.	watch pattern, brass, 2 in. diameter,	with stop and agate centre to needle,				1.50
945.	Do.	watch pattern, brass, $1\frac{1}{2}$ inches diameter,	with hinged cover and stop to needle,				1.60

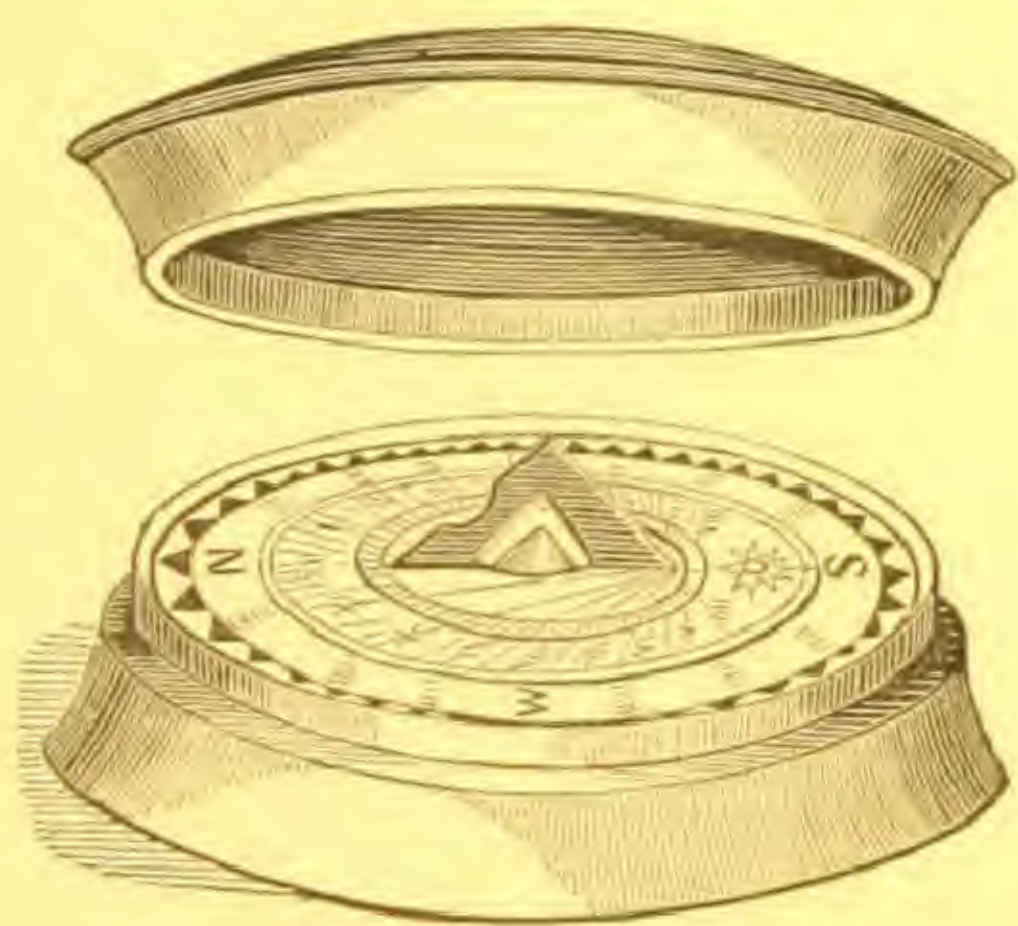
No.		PRICE
946.	Pocket Compass, watch pattern, brass, $1\frac{1}{2}$ inches diameter, with hinged cover, stop and agate centre to needle,	\$1.75
947.	Do. watch pattern, German Silver, $1\frac{1}{2}$ inches diameter, hinged cover, stop and agate centre to needle,	2.65



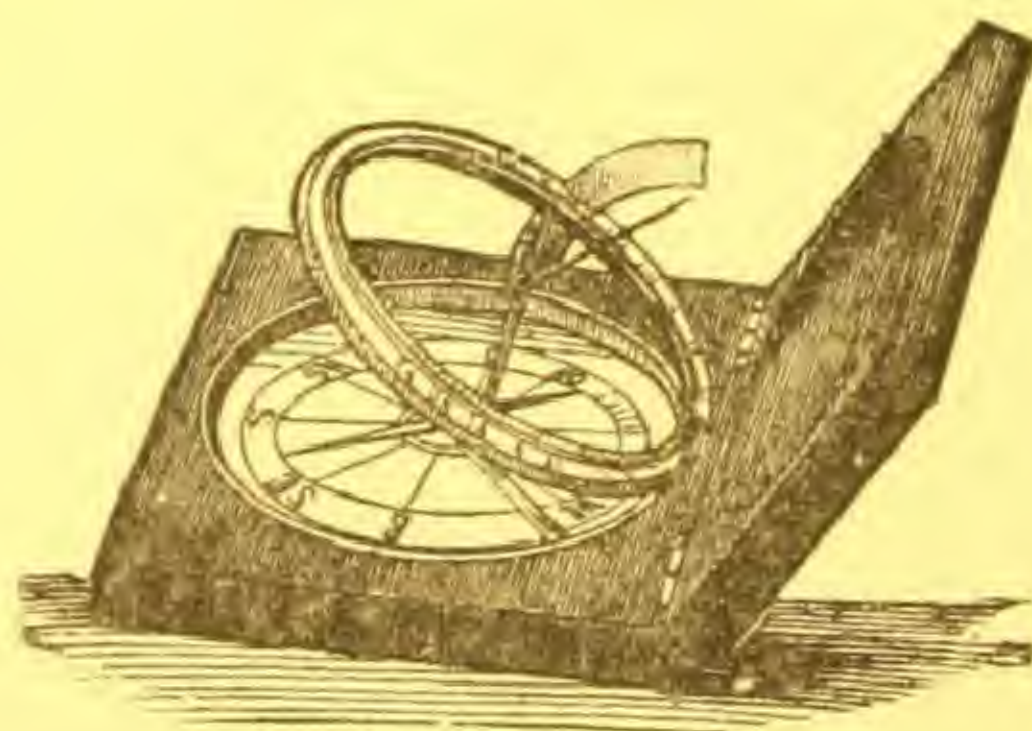
948.

948.	Pocket Compasses; gilt, watch pattern, with stop, enamelled dial and agate centre; 1 to 2 inches diameter, in morocco cases, (<i>a very superior London article, such as are used by officers in the British army,</i>) $1\frac{1}{2}$ inches diameter, each,	6 00
949.	Same as No. 948, but $1\frac{3}{4}$ inches diameter, each,	8 00
950.	Charm Compasses, gilt, to hang to watch guard, each,	25
951.	Do. solid gold, to hang to watch guard, each,	

SUN DIAL COMPASSES.

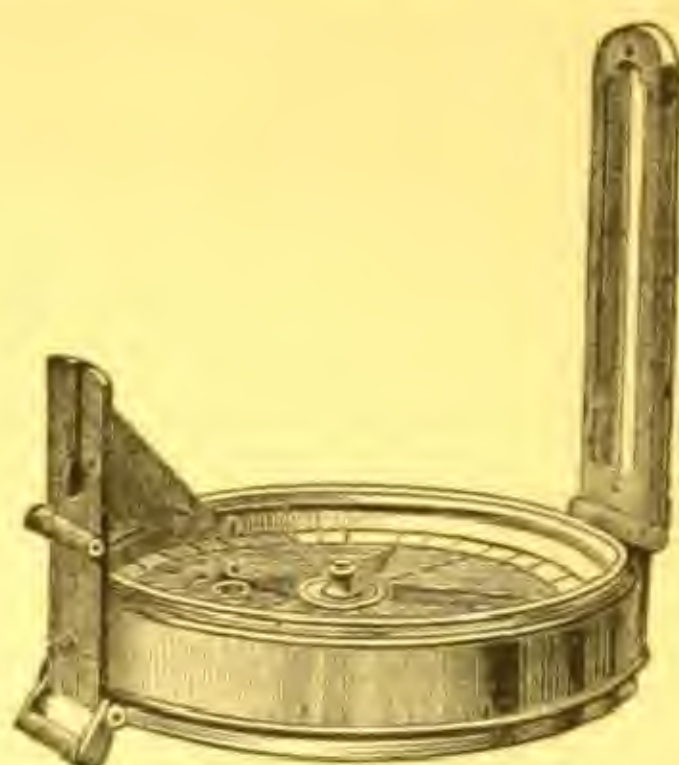


952.



953.

952.	Pocket Compass and Sun Dial, red wood box, with cover, each,	50
953.	Do. mahogany case, with Universal Sun Dial, each,	8 00
954.	Do. brass, with Levels and Leveling Screws and Universal Sun Dial, each,	14 00
955.	Do. brass, with Hinged Cover and Sun Dial, 2 in. diameter,	4 00
956.	Do. do. do. $2\frac{1}{2}$ do.	5 50



957.

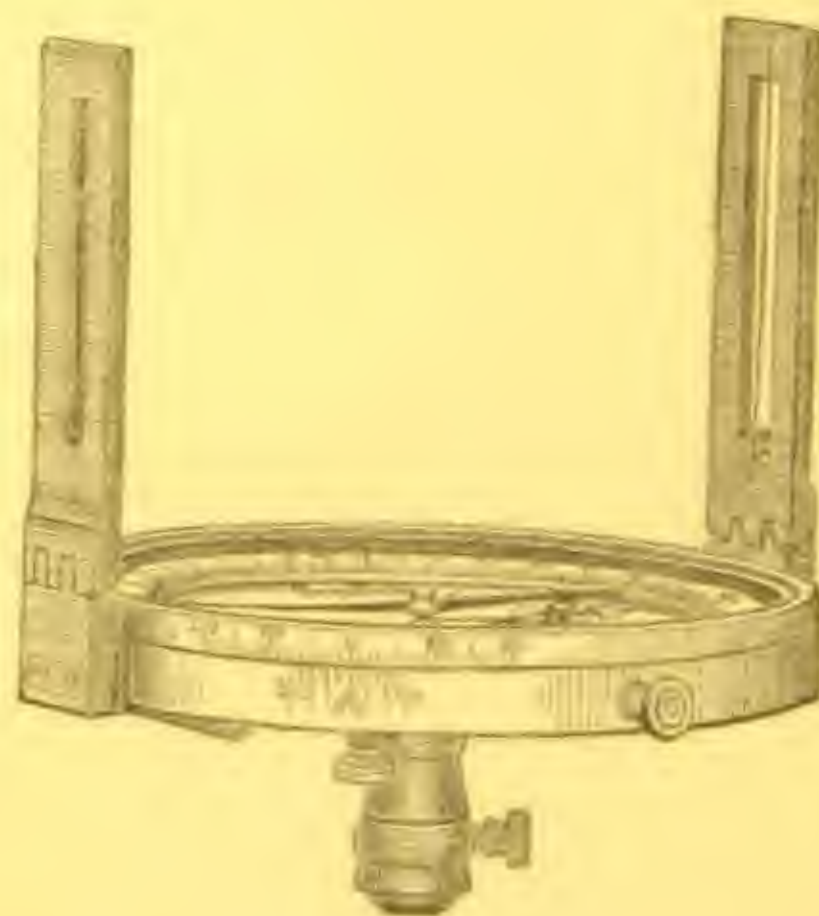


959.

No.		PRICE.
957.	Prismatic Azimuth Compass, of Brass, $2\frac{3}{4}$ inches diameter,	\$18 00
958.	Do. do. 4 do.	22 00
959.	Geological Compass, of Brass, with pendulum for ascertaining the angle of dip in rocks, each,	4 50
960.	Geological Compass, same as No. 959, but made of German Silver,	5 50



961.



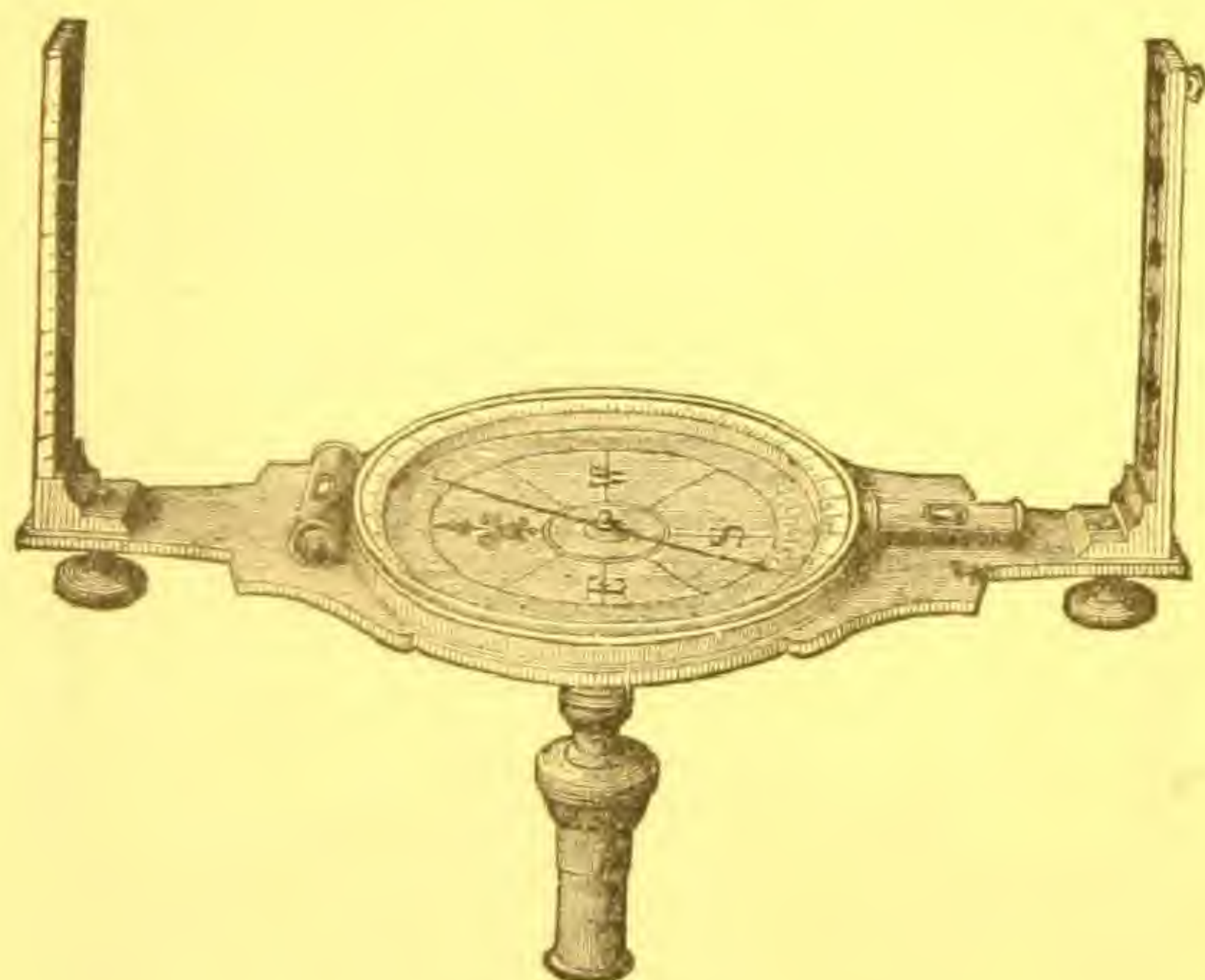
962.

961. Miner's Compass, for tracing iron ore, 12 00
- This consists essentially of a dipping needle, about $2\frac{1}{2}$ inches long, which inclines towards any mass of iron, and thus discovers its position.
- When used for tracing ore, the observer should hold the ring in his hand, and keep the needle north and south, standing with his face to the west.
- If held horizontal, it serves, of course, as an ordinary pocket compass.

No.	PRICE.
962. Surveying Compass, with folding sights, needle $3\frac{1}{2}$ inches long, nonius on side of compass, box for adding and subtracting magnetic variations, two straight levels, Jacob Staff mountings,	\$18 00
963. Surveying Compass, same as No. 962, but without nonius, needle $3\frac{1}{2}$ inches long,	15 00
964. Surveying Compass, same as No. 962, without levels and nonius, needle $3\frac{1}{2}$ inches long,	14 00
965. Surveying Compass, same as No. 964, but needle $2\frac{1}{2}$ inches long,	12 00

CHAPTER XII.

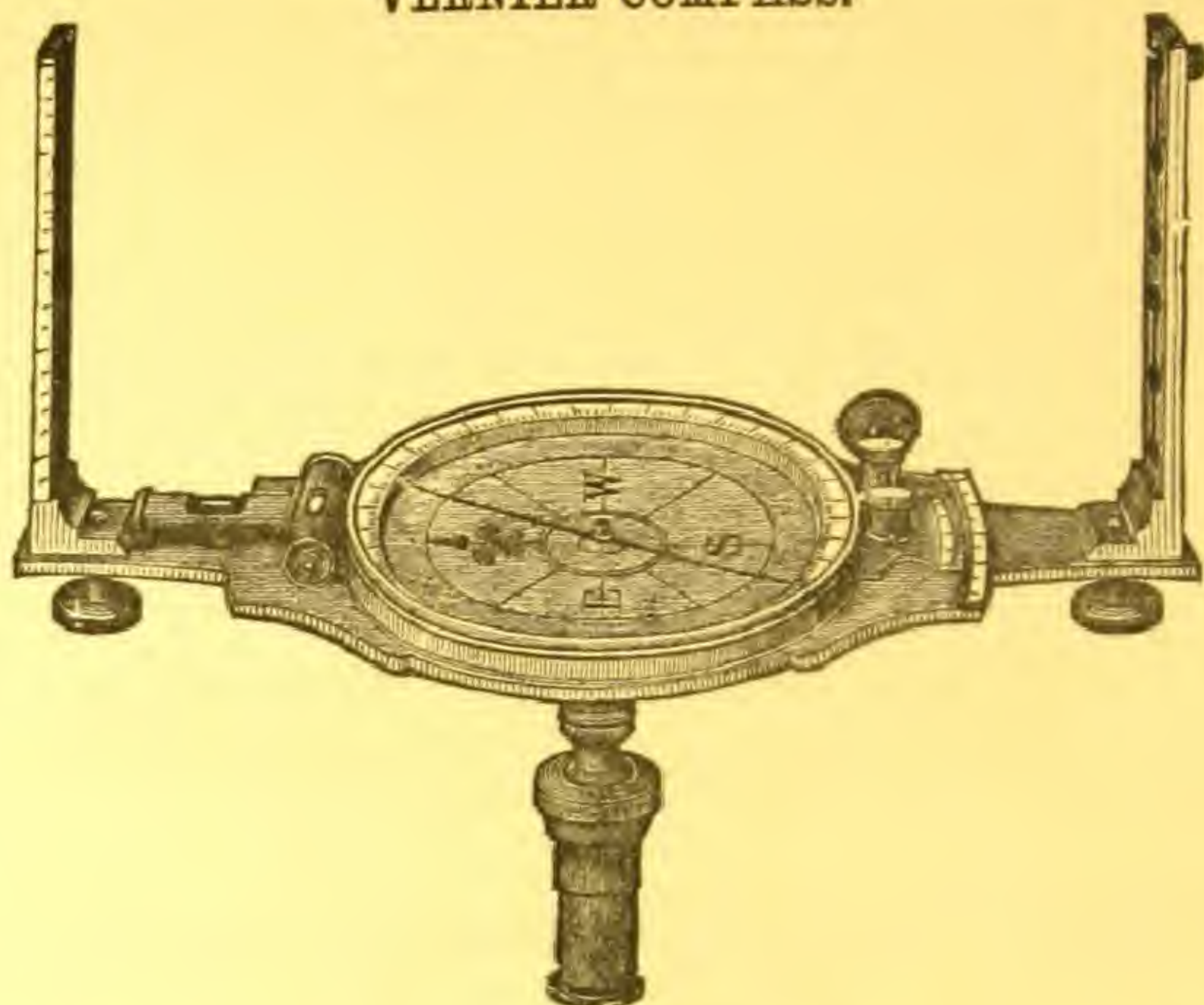
SURVEYOR'S COMPASSES, TRANSITS, LEVELS AND LEVELING RODS.



966.

966. Surveying Compass, 4 inch needle, $12\frac{1}{2}$ inch plate, two straight levels, Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	30 00
967. Surveying Compass, 5 inch needle, $15\frac{1}{2}$ inch plate, two straight levels, outkeeper and Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	35 00
968. Surveying Compass, 6 inch needle, $15\frac{1}{2}$ inch plate, two straight levels, outkeeper and Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	40 00

VERNIER COMPASS.



No.	969.	PRICE.
969.	Surveying Compass, 4 inch needle, 12½ inch plate, two straight levels, outkeeper and nonius for adding or subtracting the magnetic variations of the needle, and sights graduated for reading angles of elevation and depression,	\$40 00
970.	Surveying Compass, same as No. 969, but with 5 inch needle and 15½ inch plate,	45 00
971.	Surveying Compass, same as No. 969, but has 6 inch needle and 15½ inch plate,	50 00

THE RAILROAD COMPASS.



973.

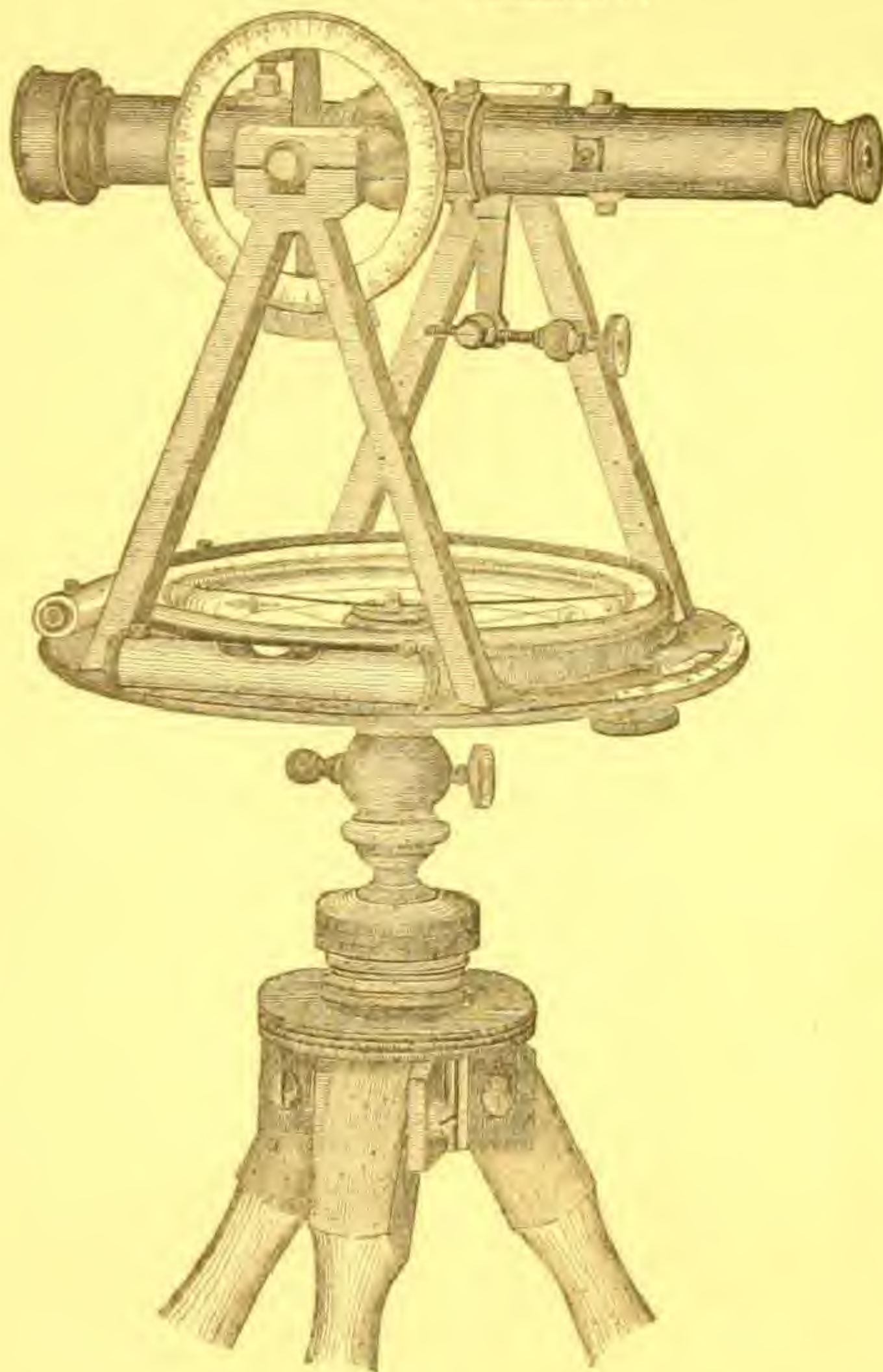
The Railroad Compass has the Main Plate, Levels, Sights and Needle of the ordinary Surveying Compass, but has also underneath the main plate a divided circle or limb by which horizontal angles to single minutes can be read independently of the needle.

973.	Railroad Compass, 5 inch needle and with one vernier to limb, and sights graduated to read angles of depression or elevations,	\$65 00
------	--	---------

No.	PRICE
974. Railroad Compass, 5½ inch needle and with one vernier to limb, and sights graduated to read angles of depression or elevations, . . .	\$70 00
975. Railroad Compass, 5½ inch needle and with two verniers to limb, and sights graduated to read angles of depression or elevations, . . .	80 00
976. Tripod, with cherry legs, furnished to any of the Compasses from No. 962 to 975, . . .	8 00
977. Tripod, with cherry legs, with parallel plates and leveling screws and clamp and tangent movement, furnished to any of the Compasses from 962 to 975, . . .	18 00

All the Compasses from No. 966 to 975 inclusive, are packed in handsome Mahogany Boxes.

VERNIER TRANSIT.



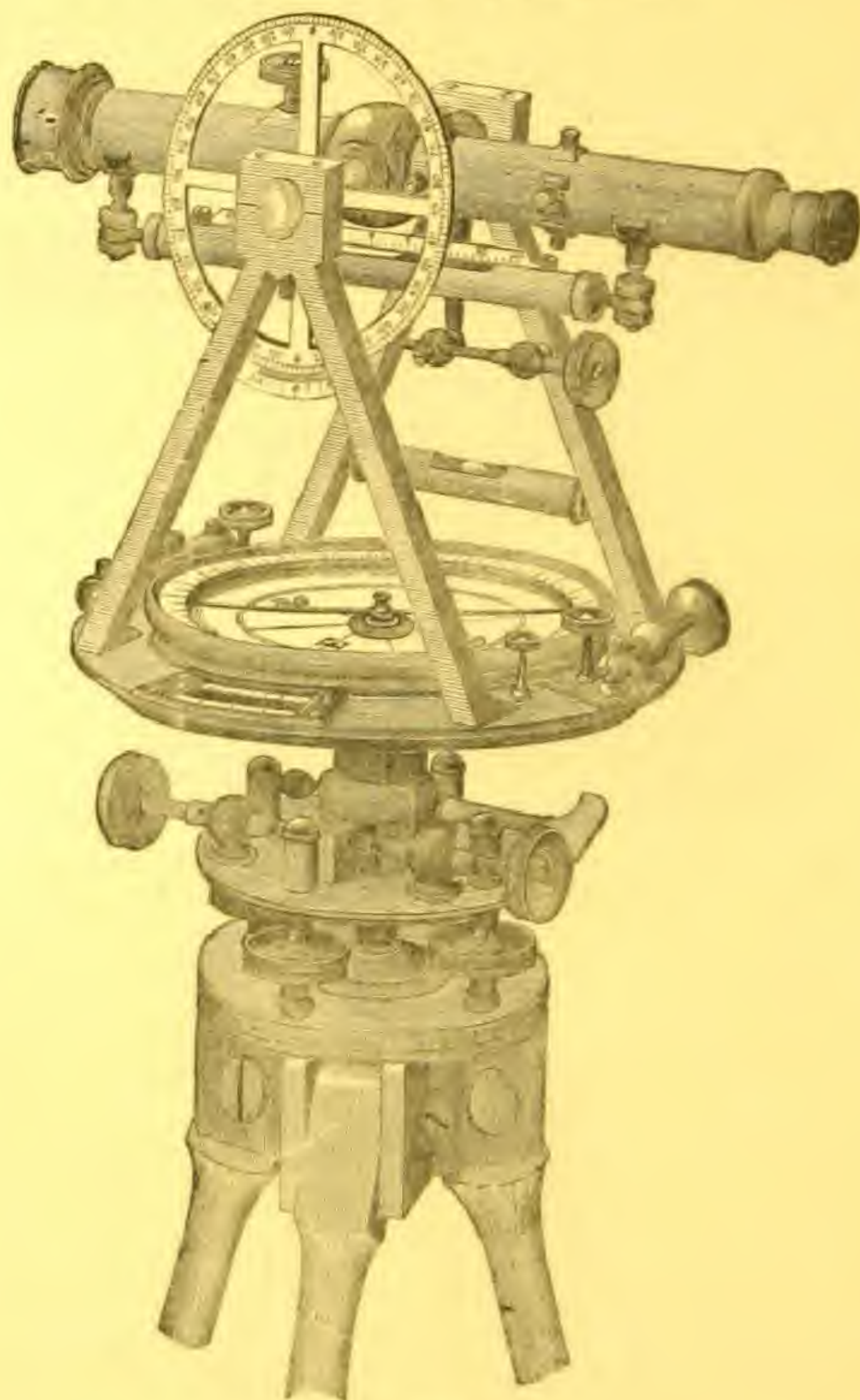
979.

The Vernier Transit, or Transit Compass, has the same general properties as the Vernier Compass No. 969, but is furnished with a Telescope in place of the ordinary sights. The Telescope is from ten to twelve inches long, and sufficiently powerful to see and set a flag at a distance of two miles, in a clear day.

978. Transit Compass, with needle 4 inches long, and light tripod, . . .	\$75 00
979. Transit Compass, same as No. 978, but with vertical circle 3½ inches diameter and clamp and tangent movement to Telescope, . . .	90 00
980. Transit Compass, with needle 5 inches long and light tripod, . . .	80 00
981. Transit Compass, same as No. 980, but with vertical circle 3½ inches diameter and clamp and tangent movement to Telescope, . . .	95 00

No.		Price.
982.	Transit Compass, with needle 6 inches and light tripod,	\$85 00
983.	Transit Compass, same as No. 982, but with vertical circle and clamp and tangent movement to Telescope,	100 00
	Sights with folding joints on Telescope to either Transit Compass from 978 to 983,	8 00
	Right Angle Sights on standards of either Transit Compass from 978 to 983,	8 00

SURVEYOR'S TRANSITS.



985.

The Surveyor's Transit, as above illustrated, has a Telescope, from ten to twelve inches long, constructed with the finest lenses; under the telescope a level is attached for taking such levels as may occur in the practice of a surveyor. On one end of the axis of the telescope a divided circle, $4\frac{1}{2}$ inches diameter, is attached, for reading to minutes angles of elevation and depression. The rim of the compass box is divided to $\frac{1}{4}$ degrees, and is provided with a nonius for adding and subtracting the magnetic variations of the needle. The limb on the divided circle outside the compass box, is provided with two verniers at right angles to the telescope and read to minutes. The tripod head is arranged with shifting centre, for setting the instruments quickly over a given point without the trouble of altering the position of the legs. The tripod legs are made of very strong mahogany.

No.	PRICE
985. Surveyor's Transit, with two verniers to limb, level under Telescope, vertical circle $4\frac{1}{2}$ inches diameter, with clamp and tangent Screw to axis of Telescope, needle 4 inches long,	\$195 00
986. Surveyor's Transit, same as No. 985, but without vertical circle to axis of Telescope,	181 00
987. Surveyor's Transit, same as No. 985, but without level under Telescope and without vertical circle and clamp and tangent screw to axis of Telescope,	160 00
988. Surveyor's Transit, same as No. 985, but with needle 5 or $5\frac{1}{2}$ inches long,	200 00
989. Surveyor's Transit, same as No. 988, but without vertical circle to axis of Telescope,	186 00
990. Surveyor's Transit, same as No. 988, but without either level, vertical circle or clamp, and tangent screw to Telescope,	165 00
991. Surveyor's Transit, with one vernier to limb, level under Telescope, vertical circle $4\frac{1}{2}$ inches diameter, with clamp and tangent screw to axis of Telescope, needle 5 or $5\frac{1}{2}$ inches long,	175 00
992. Surveyor's Transit, same as No. 991, but without vertical circle,	161 00
993. Surveyor's Transit, same as No. 991, but without either level, vertical or clamp, and tangent screw to Telescope,	140 00

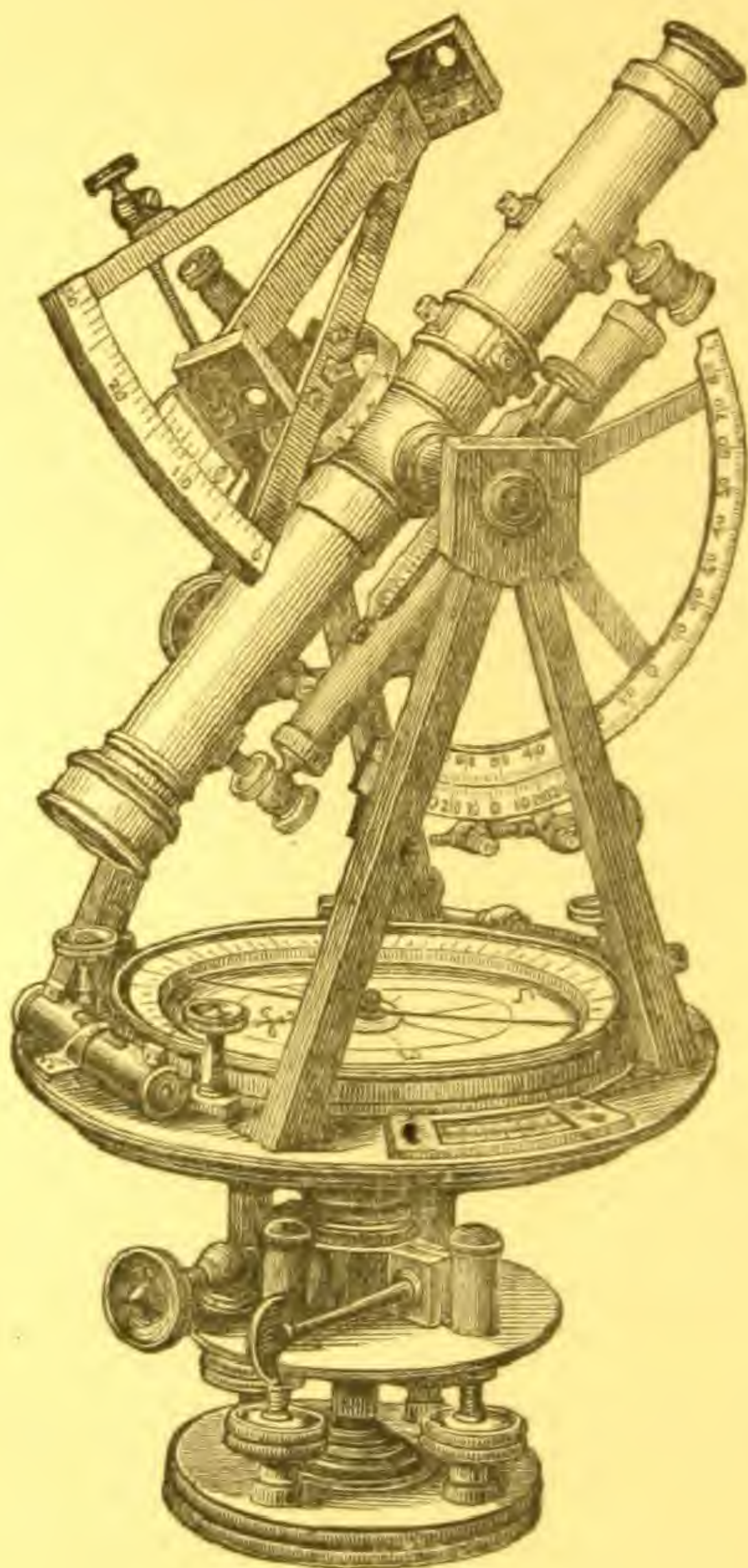
The Surveyor's Transits, from No. 985 to 993, weigh about 13 lbs. each.

ENGINEER'S TRANSIT.

The description given on page 73 for the Surveyor's Transit will apply for the Engineer's Transit, excepting that the latter has the axis or centre running from the lower parallel plate of the tripod head to the centre plate of the instruments, thus securing greater accuracy for laying of angles. The upper part of the Transit does not separate from the tripod head, as in the Surveying Transit, but is permanently attached to the parallel plates and leveling screws, and when put in its box, is unscrewed from the tripod at the lower parallel plate. See cut on first page of cover.

994. Engineer's Transit, with two verniers to limb, level under Telescope, vertical circle $4\frac{1}{2}$ inches diameter, with clamp and tangent screw to axis of Telescope, 4 inch needle,	\$210 00
995. Engineer's Transit, same as No. 994, but without vertical to axis of Telescope,	196 00
996. Engineer's Transit, same as No. 994, but without either level, vertical circle or clamp and tangent screw to Telescope,	175 00
997. Engineer's Transit, with two verniers to limb, level under Telescope, vertical circle and clamp and tangent screw to Telescope, needle $4\frac{1}{2}$ or 5 inches long,	215 00
998. Engineer's Transit, same as No. 997, but without vertical circle, to axis of Telescope,	201 00
999. Engineer's Transit, same as No. 997, but without either level under Telescope, vertical circle or clamp, and tangent screw to Telescope,	180 00

All the Transit Instruments from No. 978 to 999 inclusive, are furnished with handsome Mahogany Boxes.

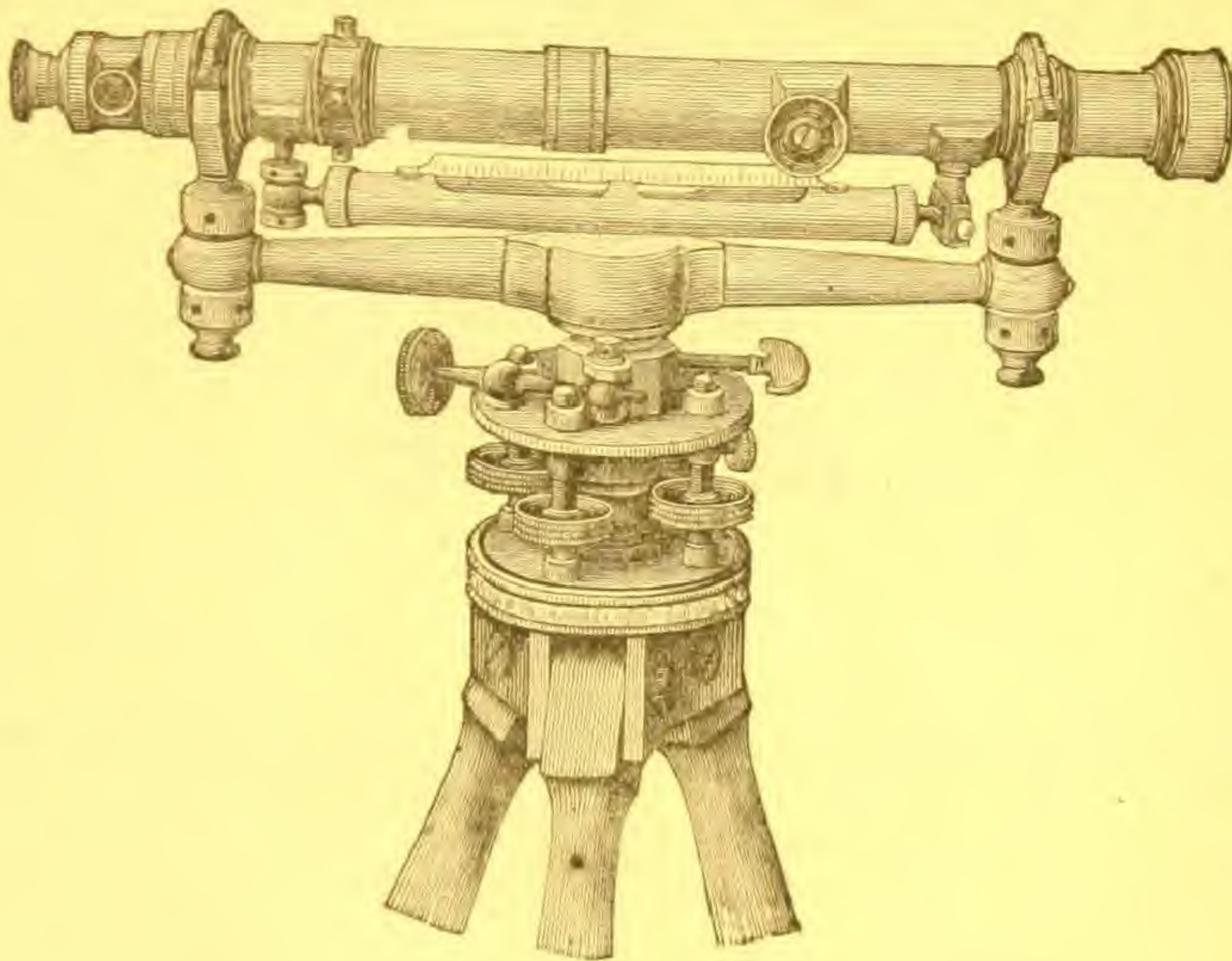


1002.

SOLAR TRANSIT.

No.		PRICE.
1001.	Burt's Solar Compass, with Adjusting Socket and Levelling Tripod, .	\$220.00
1002.	Solar Transit, with Tripod, .	241.00
1003.	Patent Solar Attachment for Transits, .	60.00
1004.	Vertical Arc divided on Silver, with Vernier, reading to 30 seconds, with movable Tangent Screw, .	20.00

ENGINEER'S LEVEL.

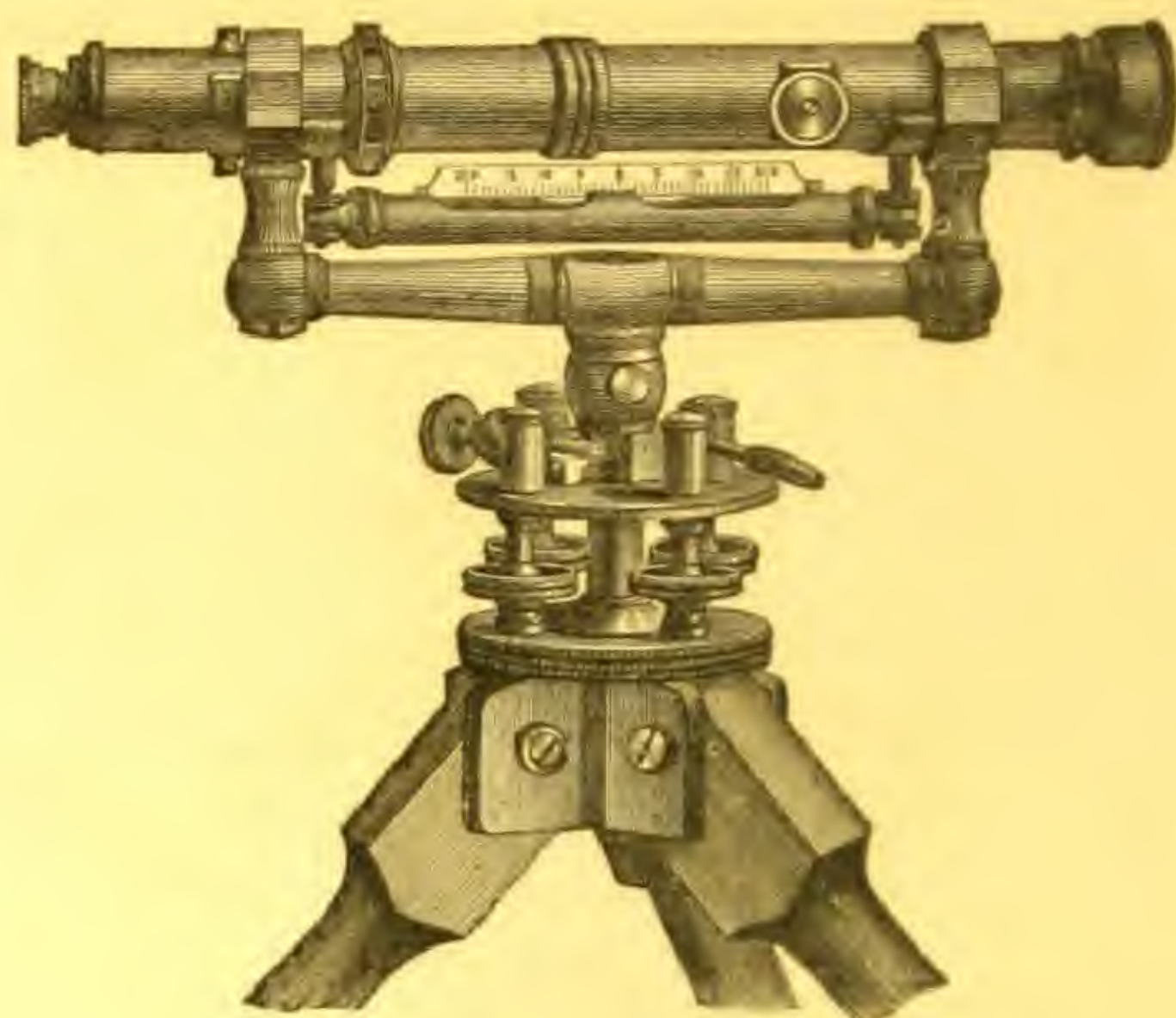


1005.

No.

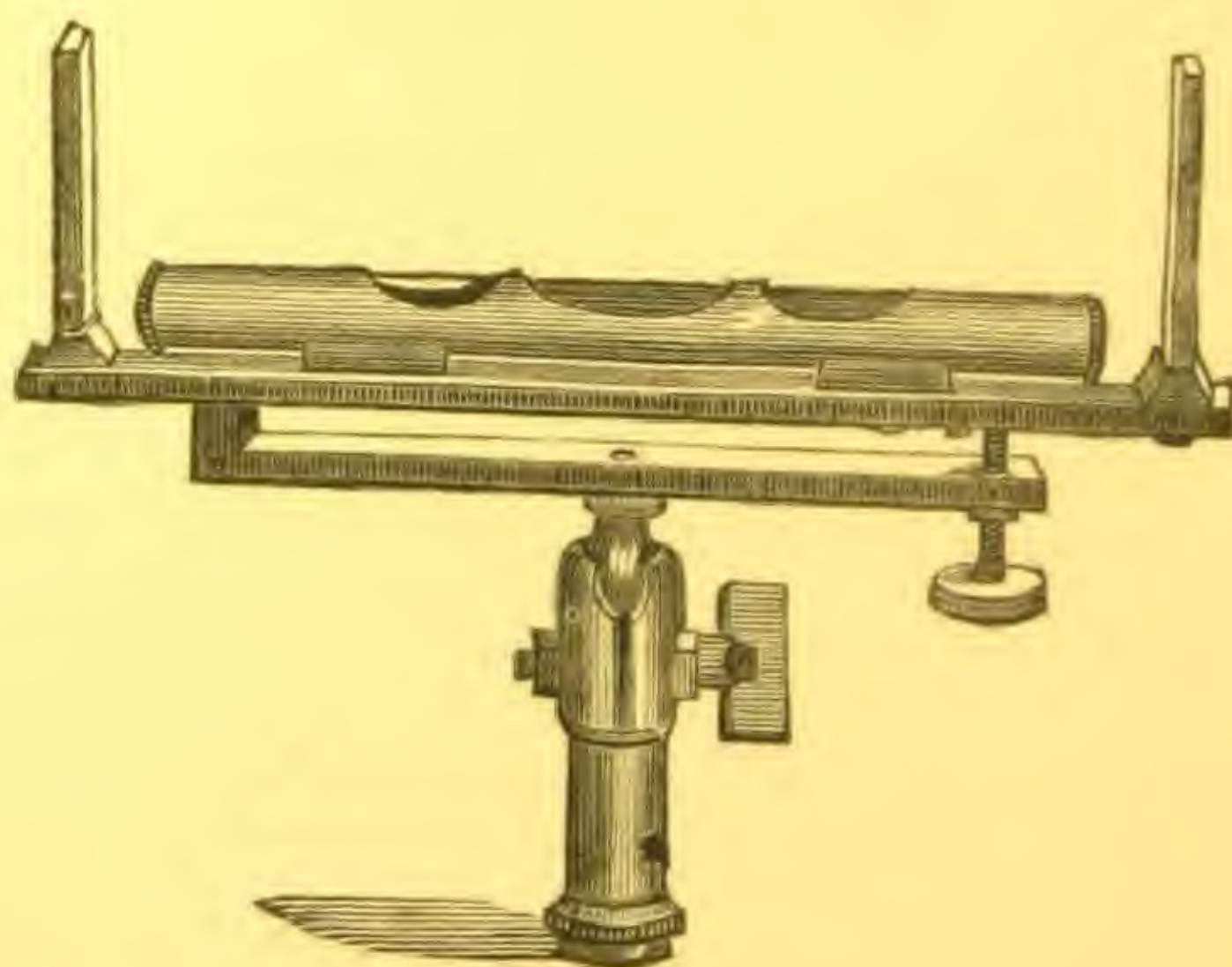
PRICE

1005. Y Level, of the most approved form and construction, with Telescope either 16, 18, 20 or 22 inches long. In this instrument the Telescope is made to revolve readily and truly in the Ys by rings of bell-metal, which, when desired, may be firmly clamped by the clips, and held in any position. It has a rack-and-pinion movement to both object and eye glasses, an adjustment for centering the eye-piece, and another for insuring the accurate projection of the object glass in a straight line. Both of these are completely concealed from observation and disturbance by a thin ring, which slides over them. The Ys of this level are made large and strong, of the best bell-metal, and each have two nuts, both being adjustable with the ordinary steel pin. The level bar is made round, of well-hammered brass, and shaped so as to possess the greatest strength in the parts most subject to sudden strains. The tripod head has the same plates and leveling screws as that of the Engineer's Transit, . . . \$135 00



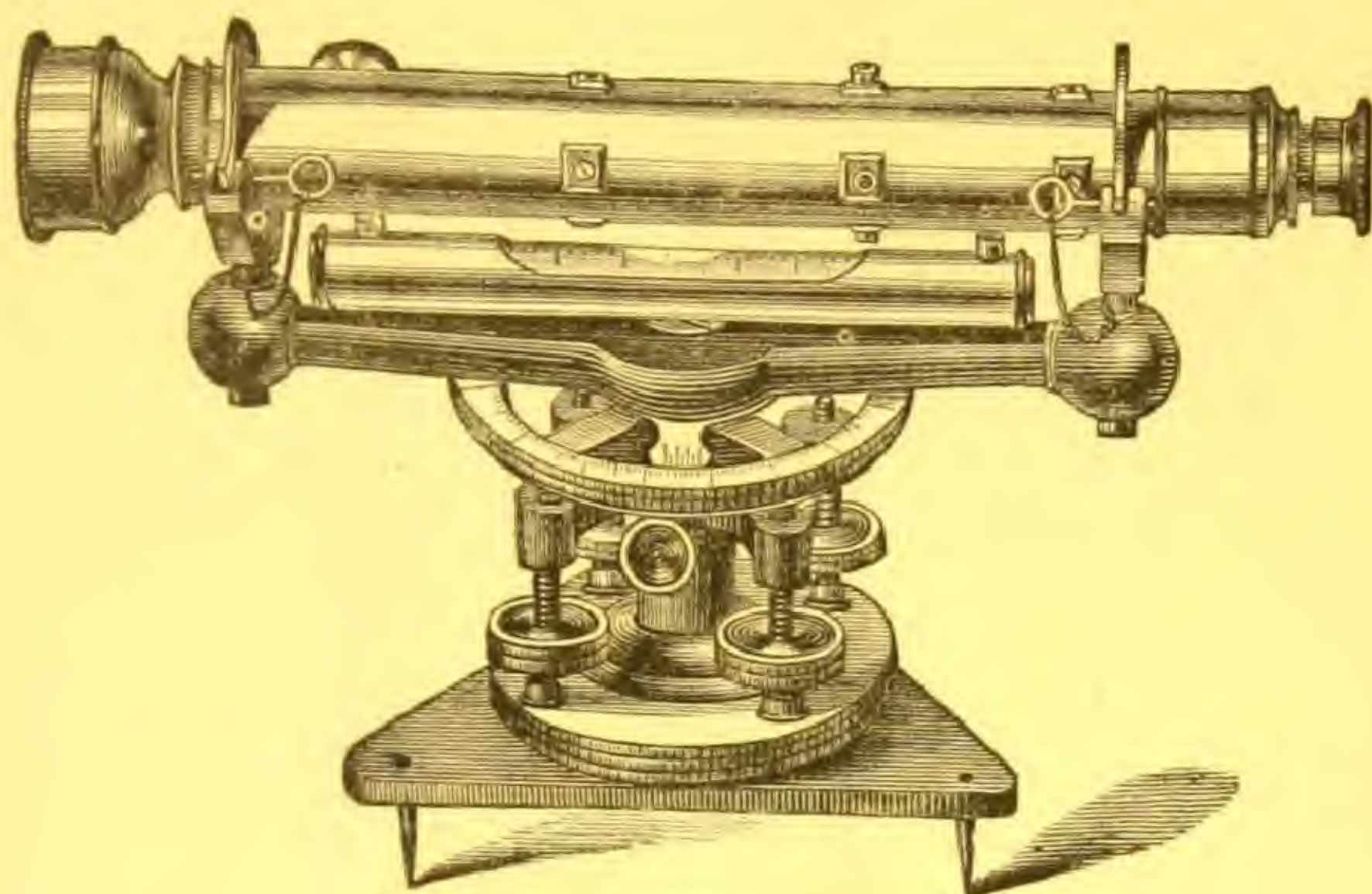
1006.

No.						PRICE.
1006.	American Dumpy or Builder's Level,	with Telescope	15 inches long,		\$75 00	
1007.	Do.	do.	do.	11 do.	60 00	



1008.

1008. French Leveling Instrument, without Telescope,	25 00
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1009.

No.	PRICE.
1009. The Architect's Level, including Tripod, Plumb-Bob, Box, &c., .	\$35.00

The instrument represented in the cut is intended to meet a want long felt by every intelligent architect, builder, millwright, and agriculturist — of a simple, compact, and serviceable Level, procurable at a very moderate cost.

It has a telescope of 11 inches, having the usual cross wires, and adjustable arrangement of the object and eye tubes, for focussing upon near and distant objects, and mounted in Y's, which are inserted in the ends of a round horizontal bar — one of the Y's being set firmly in the bar, the other, moving up or down as desired, by turning a capstan head screw shown underneath.

The telescope is held firmly in the wyes by the movable clips and pins, as shown; but when the pins are taken out and the clips raised, can be turned around in the wyes or taken entirely out, as desired.

On the bar, and directly under the telescope, is attached the level tube containing a ground-glass vial, marked by short divisions, which serve to centre the bubble.

The screws which connect the ends of the level with the bar serve, in connection with concealed springs, underneath, to adjust the level.

The spindle is connected with the bar above by a large screw as shown, and is accurately fitted below into a hollow cylinder or socket, having four arms, through the enlarged ends of which pass the ordinary levelling screws.

A horizontal circle of 3 inches diameter is connected by its hub with the upper end of the socket, and turns readily upon it.

The circle is graduated to degrees, and figured from 0 to 90 each way; it is *read* by a little vernier, which turns with the spindle, to five minutes of a degree.

The telescope is directed to any object by hand, the spindle turning readily in its socket, but can be clamped in any position by the little milled head screw, shown under the circle.



1010.



1011.



1012.

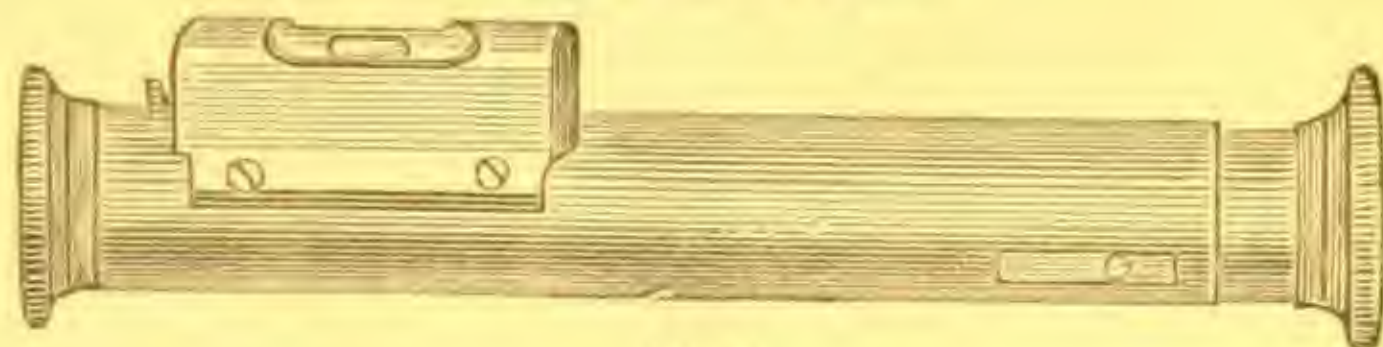


1013.

- | No. | Description | PRICE. |
|-------|--|---------|
| 1010. | Philadelphia Leveling Rod, made of seasoned mahogany. | \$18.00 |
| 1011. | New York Leveling Rod, made of seasoned satin wood. | 16.00 |
| 1012. | Boston Leveling Rod, made of seasoned mahogany. | 16.00 |
| 1013. | Ranging Poles, 6 feet long, with steel-pointed shoe, and divided off in feet, which are painted red and white, alternately. | 4.00 |
| 1014. | Ranging Poles, 8 feet long, with steel-pointed shoe, and divided off in feet, which are painted red and white, alternately. | 4.50 |
| 1015. | Ranging Poles, 10 feet long, with steel-pointed shoe, and divided off in feet, which are painted red and white, alternately. | 5.00 |

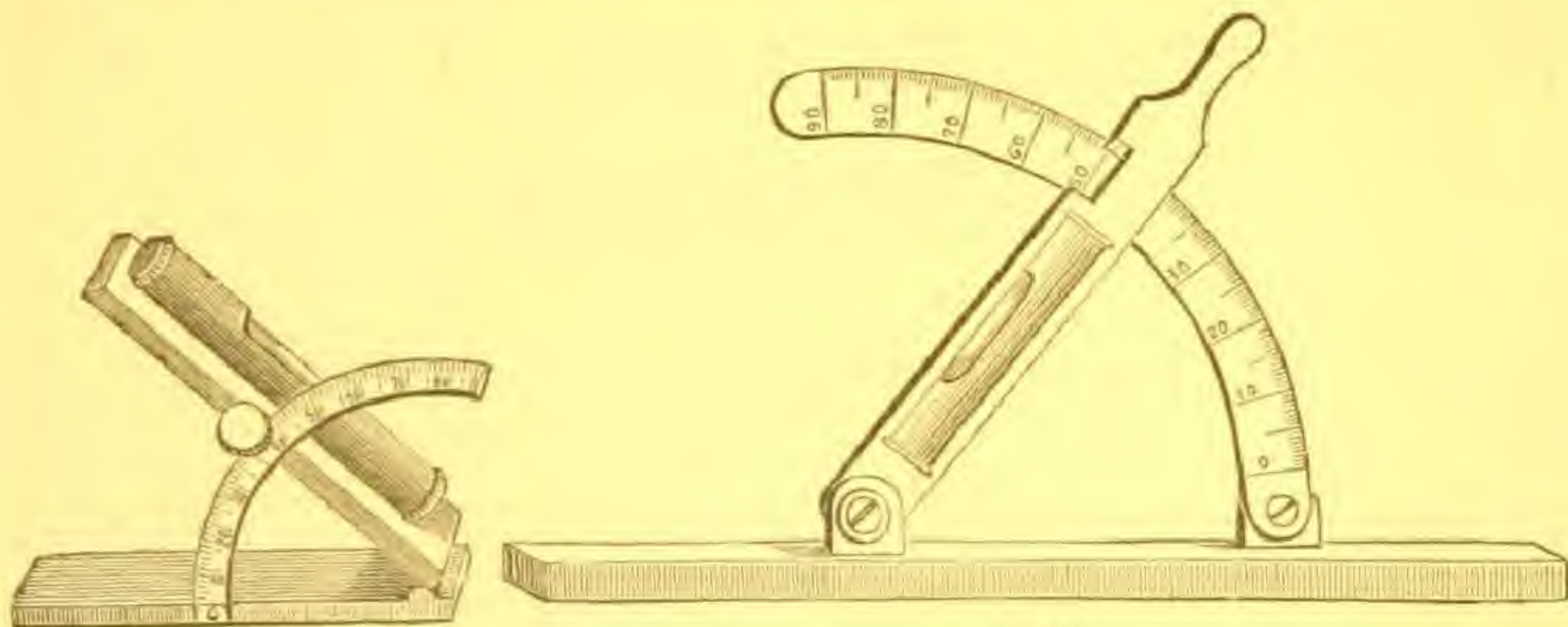
No.		PRICE.
1015½.	Steel Ranging Poles, 7 feet long, very accurate,	\$6.25
1016.	Rod Level for Plumbing Rod or Pole,	5.00
1016½.	Plummet Lamps, for Mining use, with Compensating Ring,	13.00
	Pair in box, with Strap,	28.00
1016¾.	Lamp for Mining Engineers of Copper, with Air Chamber, can be used on hat, in hand, or on table,	3.00

HAND LEVELS.



1017.

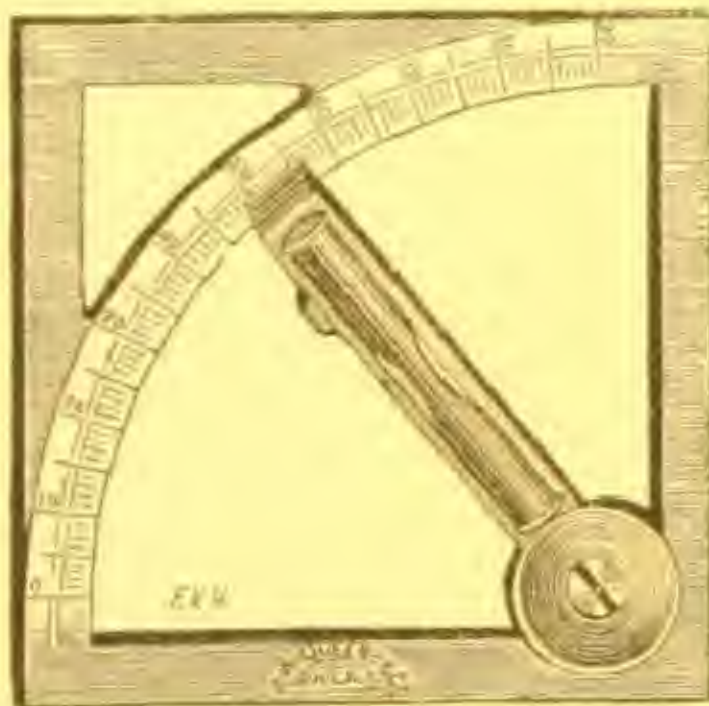
1017.	Locke's Hand Level, made of German Silver,	12.00
1018.	Do. do. do. Brass,	10.00
1018½.	Reflecting Hand Mirror, for turning right angles,	10.00



1019.

1020.

1019.	Clynometer or Slope Level, small size, in morocco box,	8.00
1020	Do. do. large size, do.	12.00
1021.	Do. do. with perpendicular sights,	15.00



1021½.

1021½.	Clynometer of Square Frame, with arc running diagonally across, in box,	12.00
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This last form gives these instruments great firmness, and either of the four sides can be used for ascertaining the slope, thus enabling one to take the inclination of the under side of a plane.

1021 $\frac{3}{4}$.

No.		PRICE.
1021 $\frac{3}{4}$.	Linton's Patent Combined Hand Level and Clinometer,	\$20.00
1022.	Pocket Levels, mounted in Brass, 3 inches long, . . . . .	.75



1022.

1023.	Pocket Levels, mounted in Brass, 6 inches long,	1.50
1024.	Do. do. do. 9 do.	2.25
1025.	Do. do. do. 12 do.	3.00
1026.	Ground Level Bulbs, 2 to 6 inches long, each from . . . . .	.50 to 2.50
1027.	Unground do. do. do. do. . . . .	.12 to .50
1027 $\frac{1}{2}$.	Round Pocket Level in case, mounted in brass, 2 $\frac{3}{4}$ inches in diameter,	2.00

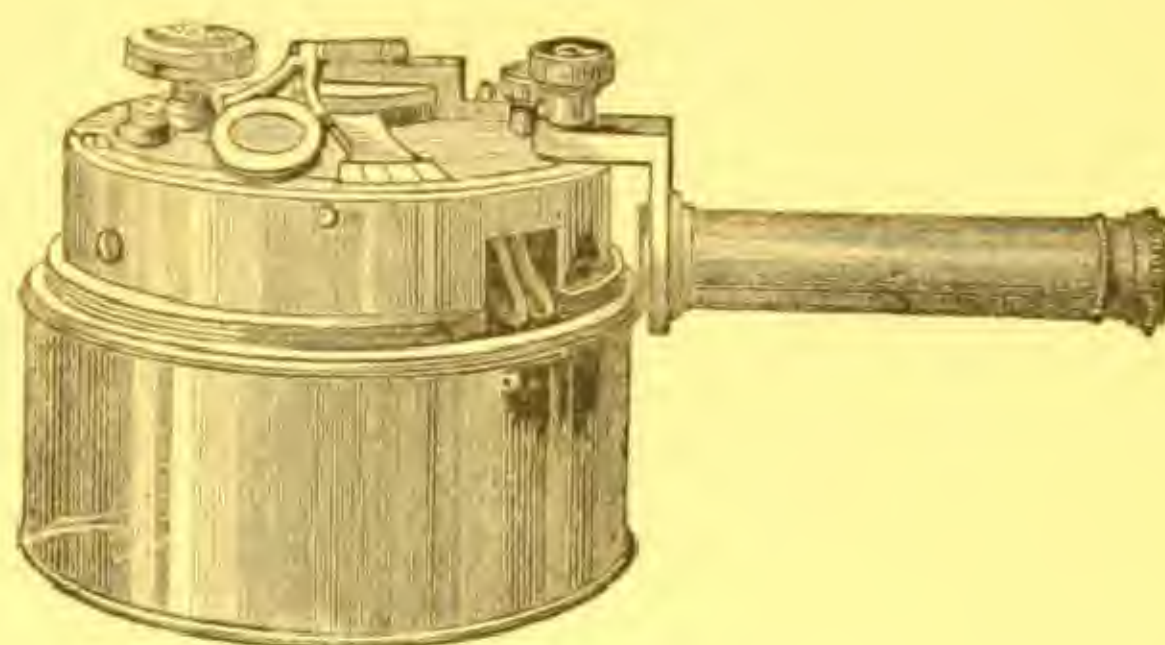
Very delicate Ground Levels mounted to order.

CHAPTER XIII.

POCKET SEXTANTS, ODOMETERS, CHAINS, TAPE MEASURES AND POCKET RULES.



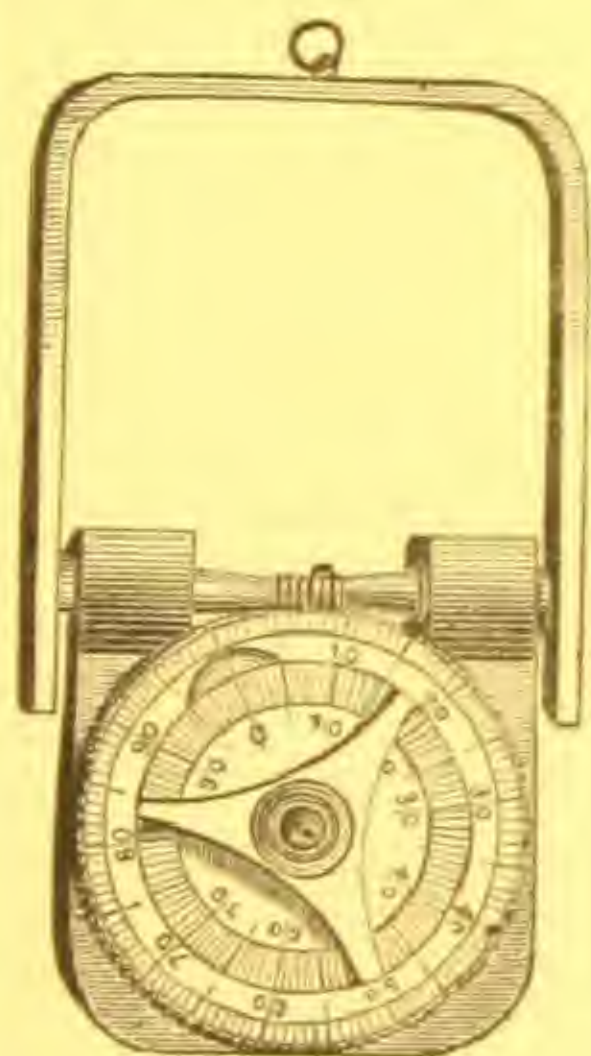
1028.



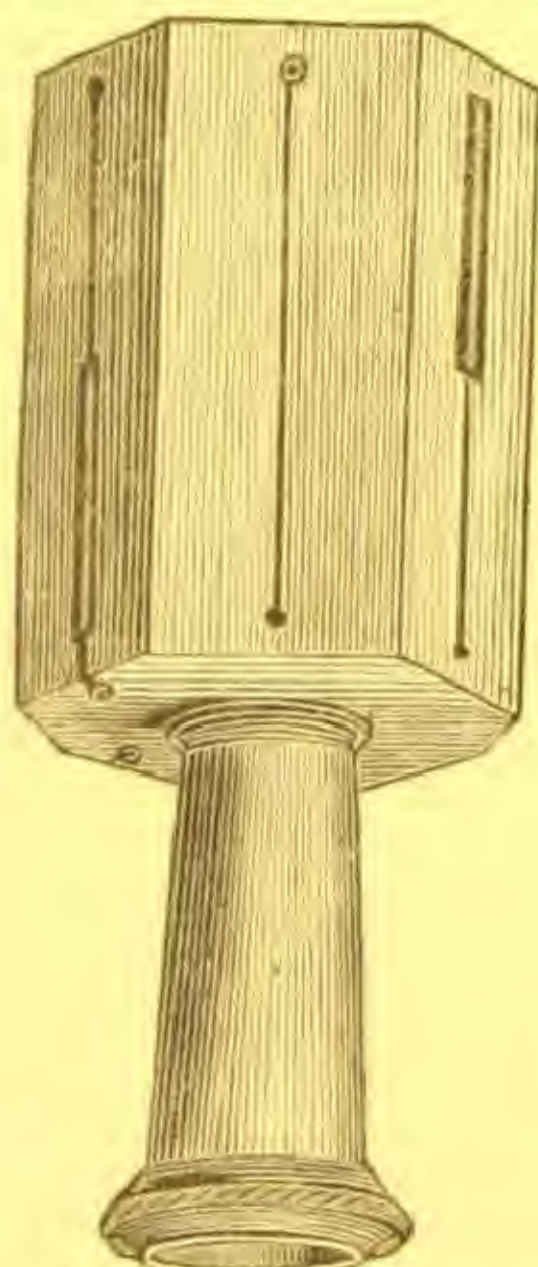
1030.

No.		Price
1028.	Pedometer, an instrument for measuring distances walked, watch form and size, German silver case,	
1029.	Do. silver case,	\$17 00
1030.	Pocket Sextant with Telescope, very accurate,	21 00
1031.	Odometer, for measuring distances traveled by a carriage,	50 00
1031½.	Surveyor's Cross, for turning right angles,	20 00
		3 00

SURVEYOR'S AND ENGINEER'S CHAINS.



1031.



1031½.



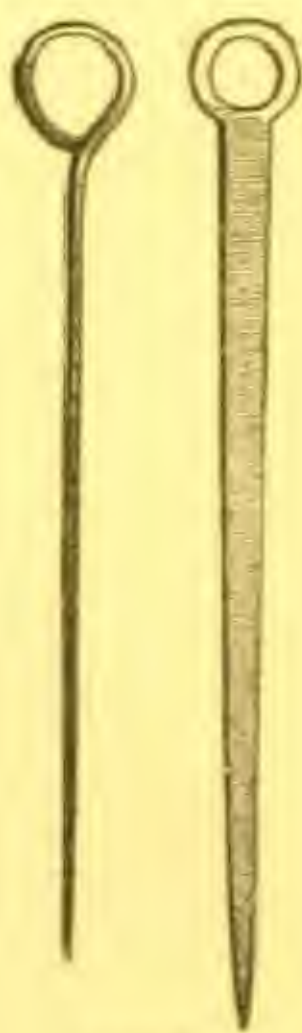
1032.

1032.	Surveyor's Chain, 2 poles, 50 links, No. 9, wire oval rings,	2 00
1033.	Do. 2 do. 40 do. 8, do.	2 75
1034.	Do. 2 do. 50 do. 8, do.	2 75
1035.	Do. 2 do. 50 do. 7, do.	3 75
1036.	Do. 4 do. 100 do. 9, wire round rings,	2 50

No.						PRICE.
1037.	Surveyor's Chain,	4 poles,	100 links,	No. 8,	wire oval rings,	\$4 50
1038.	Do.	4 do.	100	do.	7, do.	5 50
1039.	Do.	4 do.	100	do.	12, best steel wire, brazed links and rings,	14 00
1040.	Do.	2 do.	50	do.	12, best steel wire, brazed links and rings,	7 00
1041.	Engineer's Chain,	50 feet,	50	do.	7, wire,	4 00
1042.	Do.	100 do.	100	do.	7, do.	6 00
1043.	Do.	50 do.	50	do.	12, best steel wire, brazed links and rings,	8 00
1044.	Do.	100 do.	100	do.	12, best steel wire, brazed links and rings,	15 00

GRUMMAN'S PATENT CHAINS.

1045.	66 feet,	No. 15 Tempered Steel Wire,	100 links,	weight $1\frac{1}{4}$ lbs.,	with 10 extra links,	10 00
1046.	33 feet,	No. 15 Tempered Steel Wire,	50 links,	weight $\frac{3}{4}$ lbs.,	with 5 extra links,	6 00
1047.	100 feet,	No. 15 Tempered Steel Wire,	200 links,	weight 2 lbs.,	with 15 extra links,	14 00
1048.	50 feet,	No. 15 Tempered Steel Wire,	100 links,	weight 1 lb.,	with 10 extra links,	8 00
1049.	33 feet,	No. 12 Wire,	5 tallies,	with 5 extra links,	weight $1\frac{1}{8}$ lbs.,	7 00
1050.	66 do.	12 do.	10	do.	10 do. 3 do.	14 00
1051.	50 do.	12 do.	5	do.	5 do. $2\frac{1}{2}$ do.	8 00
1052.	100 do.	12 do.	10	do.	10 do. $4\frac{1}{2}$ do.	15 00
1053.	Spring Balance to use with either of the above-named chains,					2 00
1054.	50 feet,	No. 18 Tempered Steel Wire,	100 links,	no rings,	with attachments of spring-balance, level and thermometer, for very accurate measurements, weight $\frac{3}{4}$ lbs.,	17 00
1055.	Set of 10 Marking Pins, very light, with leather case,					2 00
1056.	Brass Plummet, to use with light chain,					2 00
1057.	Lead do. do. do.					1 50
1057 $\frac{1}{2}$.	Marking Pins of No. 8 steel wire, 11 in a set, per set,					1 00
1057 $\frac{3}{4}$.	Do.	do.	7 iron	do.	11 do. do.	75



1058.

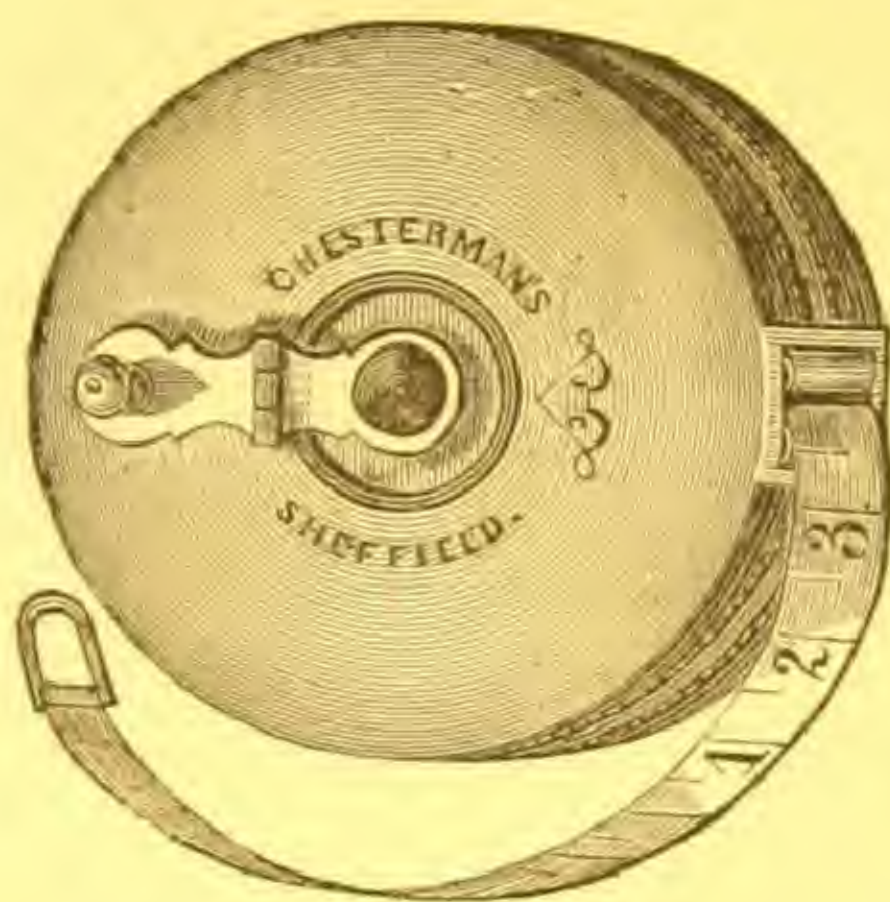


1060.

1058.	Marking Pins, of No. 6 steel wire, 11 in a set, per set,	2 00
1059.	Marking Pins, of tempered steel, 15 in. long, $\frac{3}{4}$ in. wide, 11 in a set, per set,	7 50
1060.	Plumbob, of brass, with steel point and screw top,	2 50
1061.	Same as No. 1060, but all steel,	2 50
1062.	Plumbob cord, per yard,	06



1061 1/2.



1067.

No.		PRICE
1061 1/2.	Patent Adjustable Plumb-bobs (small), 8 oz.,	\$1.75
1061 3/4.	Do. Do. (large), 13 oz.,	2.25
1062.	Plumb-bob cord, per yard,	.06

These are constructed with a reel at the upper end, upon which the line may be kept, and by dropping the bob with a slight jerk, while the ring is held in the hand, any length of line may be reeled off. A spring which has a bearing on the reel will check and hold the bob firmly at any point on the line.

TAPE MEASURES.

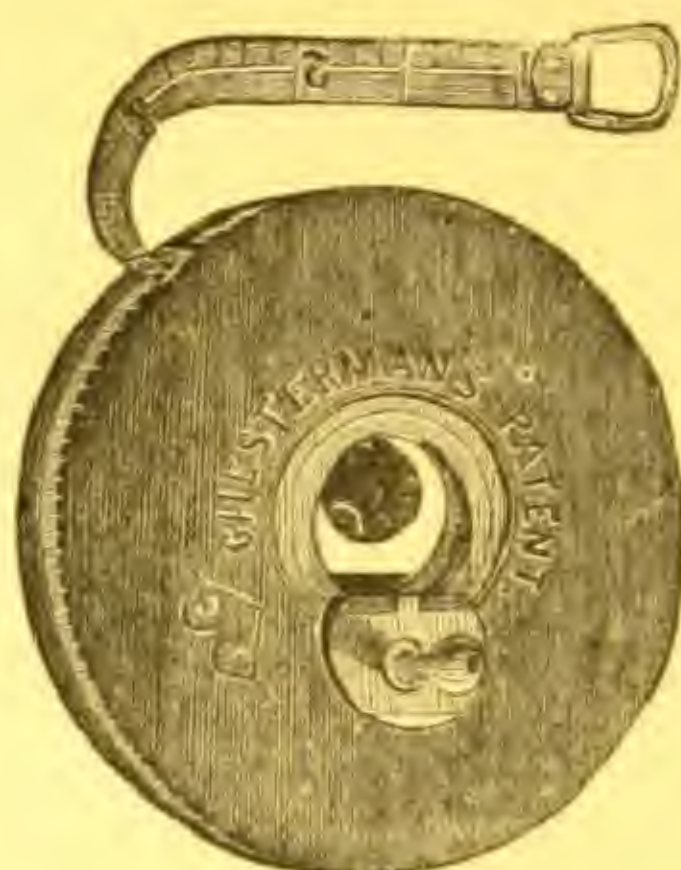
1065.	Best Linen Tape Measure, in strong leather case, 50 feet long, each,	1.85
1066.	Do. do. do. do. do. 100 do. do. .	2.75

CHESTERMAN'S METALLIC TAPE MEASURES.

These tapes are made of linen thread interwoven with fine brass wire, not so liable to stretch as the usual linen tape, and better calculated to withstand the effect of moisture. They are in substantial leather cases.

1067.	Metallic Tape Measure, 24 feet long, in 10ths or 12ths, each,	2.40
1068.	Do. do. 33 do. do. do. do. .	2.75
1069.	Do. do. 40 do. do. do. do. .	3.00
1070.	Do. do. 50 do. do. do. do. .	3.25
1070 1/2.	Same as 1070, but in case with Flush Handle,	3.75
1071.	Metallic Tape Measure, 66 feet long, in 10ths or 12ths, each,	3.75
1072.	Do. do. 70 do. do. do. do. .	4.00
1073.	Do. do. 75 do. do. do. do. .	4.25
1074.	Do. do. 80 do. do. do. do. .	4.50
1075.	Do. do. 100 do. do. do. do. .	5.25
1075 1/2.	Same as 1075, but in case with Flush Handle,	5.75

Chesterman's Metallic Tapes furnished without boxes at the following prices: 50 feet, each, \$2.00; 66 feet, \$2.50; 100 feet, \$3.50.



1076.



1085.

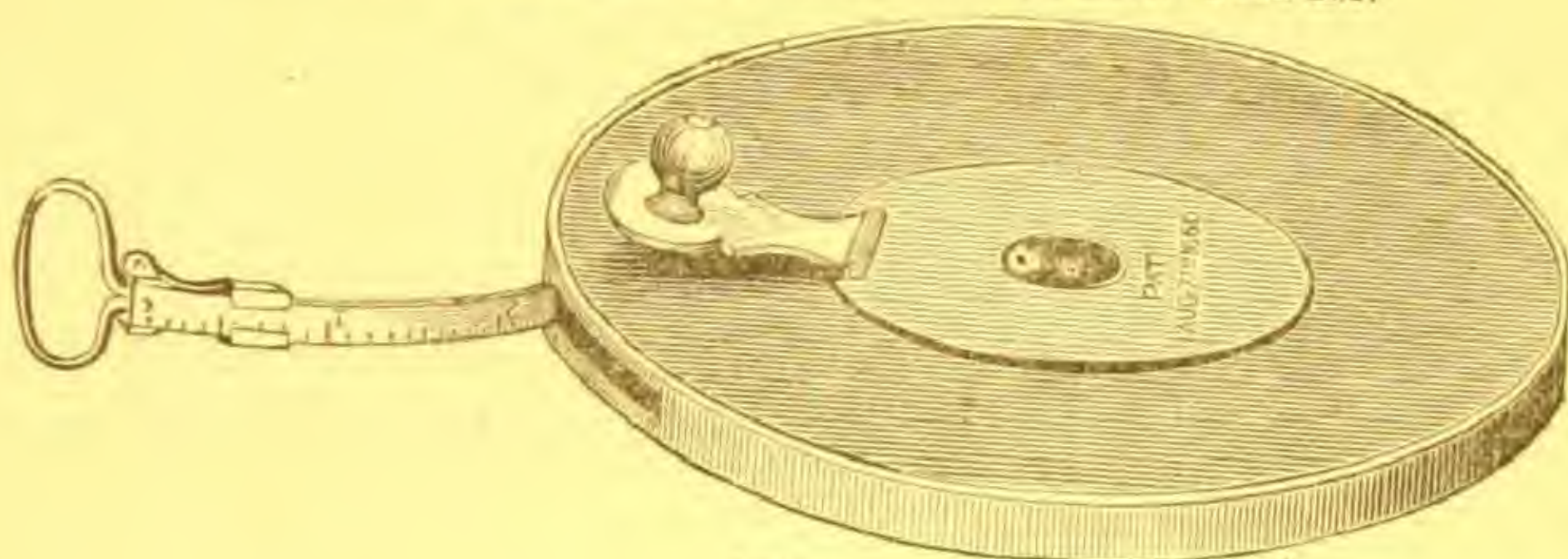
CHESTERMAN'S STEEL TAPE MEASURES.

Steel Tape Measures; all steel, to wind up in a box, same as linen measures, the most accurate, durable, and portable measures.

No.		Price.
1076.	Steel Tape Measure, 10 feet long, in 10ths or 12ths, in German Silver case, each,	\$4.00
1077.	Steel Tape Measure, 10 feet long, tape divided on one side to 12ths, and on the other to centimeters and millimeters,	4.25
1078.	Steel Tape Measure, 25 feet long, in 10ths or 12ths, each,	6.00
1079.	Do. do. 33 do. do. do. do.	7.50
1080.	Do. do. 40 do. do. do. do.	8.50
1081.	Do. do. 50 do. do. do. do.	10.00
1081½.	Same as 1081, but extra wide and heavy,	15.00
1082.	Steel Tape Measure, 66 feet long, in 10ths or 12ths, each,	13.00
1083.	Do. do. 75 do. do. do. do.	15.00
1084.	Do. do. 100 do. do. do. do.	18.00
1084½.	Steel Standard Measures, from 100 to 1000 feet, with graduations at every 50 feet.	
	Tape 100 feet, with Reel, Handle and Stop,	10.50
	Each additional 100 feet,	5.50
	Large Brass Handles, to unship, each,	1.50
	Clamping Handle, each,	1.80
	Small Brass Clamp, to fasten on tape,	.75
	Every extra graduation and figuring, each,	.20
The above Tapes are made without joints and of precise U. S. standard; usually made about 300 feet in length, with graduations at every 10 feet, the last 10 feet with graduations at every foot, and the last foot into 10ths.		
1085.	Steel Tape Measure, 3 feet long, in German Silver Case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.00
1086.	Steel Tape Measure, 4 feet long, in German Silver Case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.25
1087.	Steel Tape Measure, 5 feet long, in German Silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.50
1088.	Steel Tape Measure, 6 feet long, in German Silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.75
1089.	Steel Tape Measure, 3 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters,	2.25
1090.	Steel Tape Measure, 4 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters,	2.50

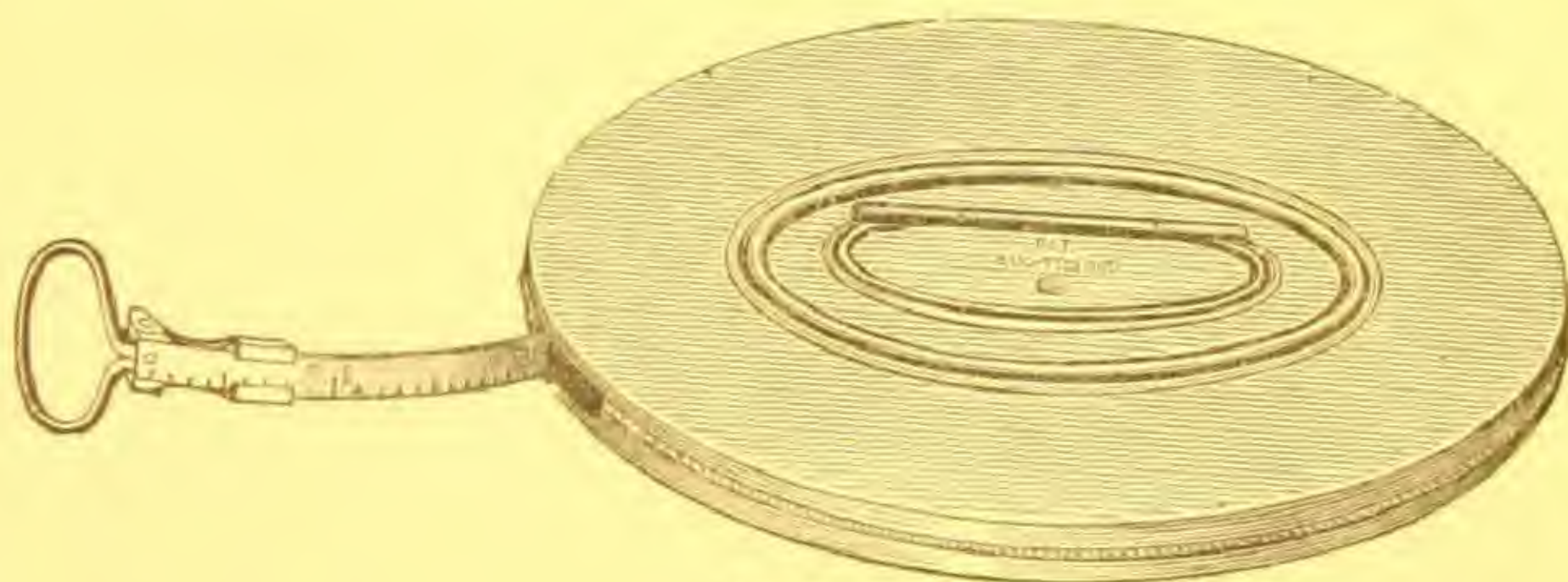
No.		PRICE.
1091.	Steel Tape Measure, 5 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters.	\$2.75
1092.	Steel Tape Measure, 6 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters.	3.00
1093.	Linen Tape Measure, 3 feet long, in silver-plated cases, with spring and stop.	.50
1094.	Linen Tape Measure, 5 feet long, in silver-plated cases, with spring and stop.	.75
1095.	Linen Tape Measure, 6 feet long, in silver-plated cases, with spring and stop.	1.00

PAINE'S PATENT STANDARD STEEL TAPES.



1096.

1096.	Standard Steel Tapes, in Japanned case, 25 feet long, 10ths or 12ths,	3.50
Do.	do. do. 33 do. do. do.	4.50
Do.	do. do. 50 do. do. do.	6.00
Do.	do. do. 66 do. do. do.	8.00
Do.	do. do. 75 do. do. do.	10.00
Do.	do. do. 100 do. do. do.	12.00



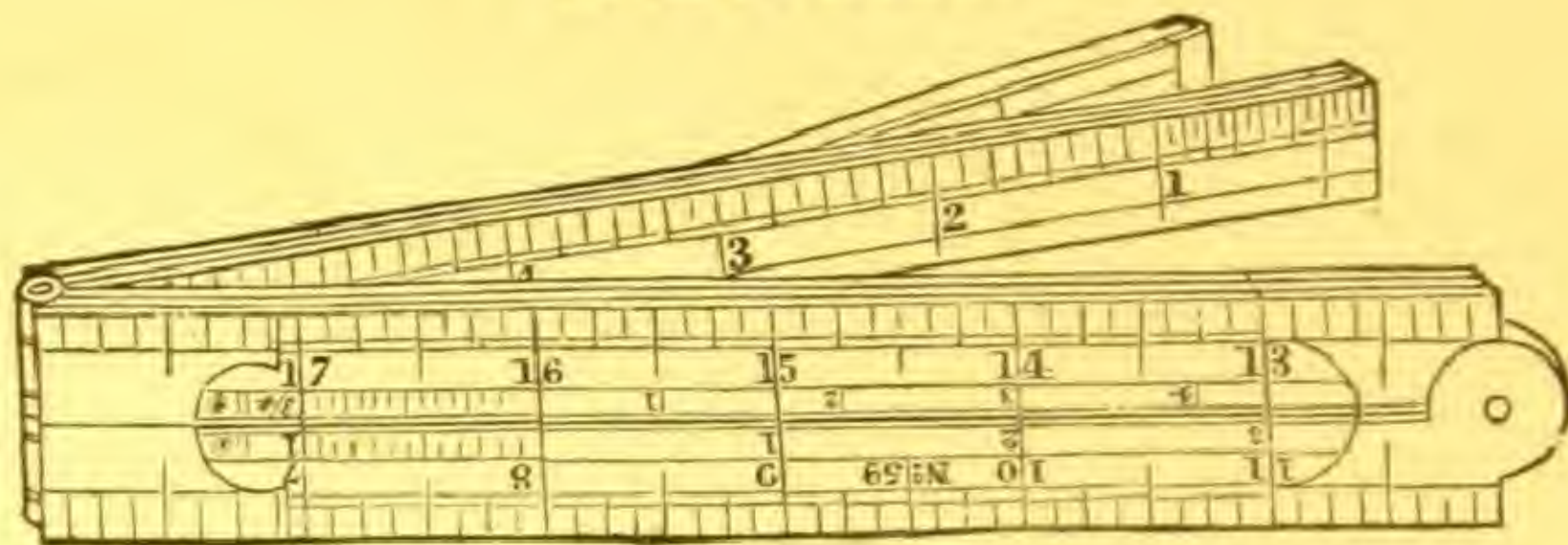
1097.

1097.	Steel Tape Measure, in leather case, flush handles, 33 ft. long, 10ths or 12ths,	5.50
Do.	do. do. 50 do. do. do.	8.00
Do.	do. do. 66 do. do. do.	10.00
Do.	do. do. 75 do. do. do.	12.00
Do.	do. do. 100 do. do. do.	15.00

EXTRAS TO PAINE'S PATENT STANDARD STEEL TAPES.

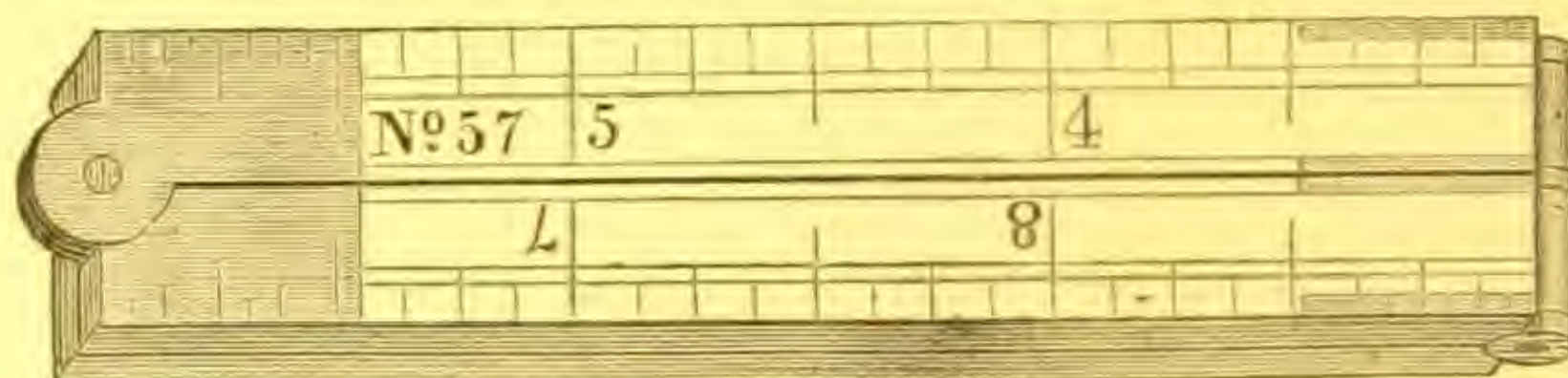
1098.	Handles, with graduated scale, per pair,	3.00
1099.	Pocket Thermometers,	1.50
1099½.	Spring Balance and Level,	4.00

POCKET RULES.



1100.

No.		PRICE.
1100.	One Foot, four Fold, boxwood, each,	\$0.25
1101.	Do. do. do. brass edges, bound, . . . . .	.75



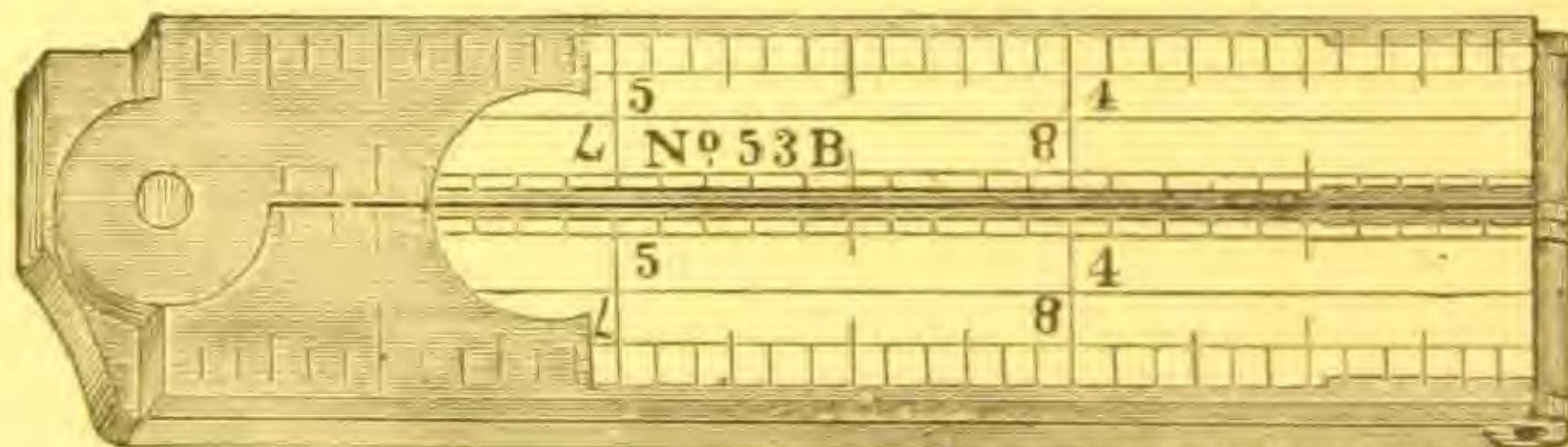
1102.

1102.	One Foot, four Fold, ivory, brass mounted,	1.00
1103.	Do. do. do. German silver mounted,	1.25



1105.

1104.	One Foot, four Fold, ivory, German silver mounted, graduated in 8ths, 10ths, 12ths, 16ths, and 100ths of a foot on edges of unbound,	2.25
1105.	One Foot, four Fold, ivory, graduated in 8ths, 10ths, 12ths, and 16ths, with German silver edges, bound,	3.00



1106.

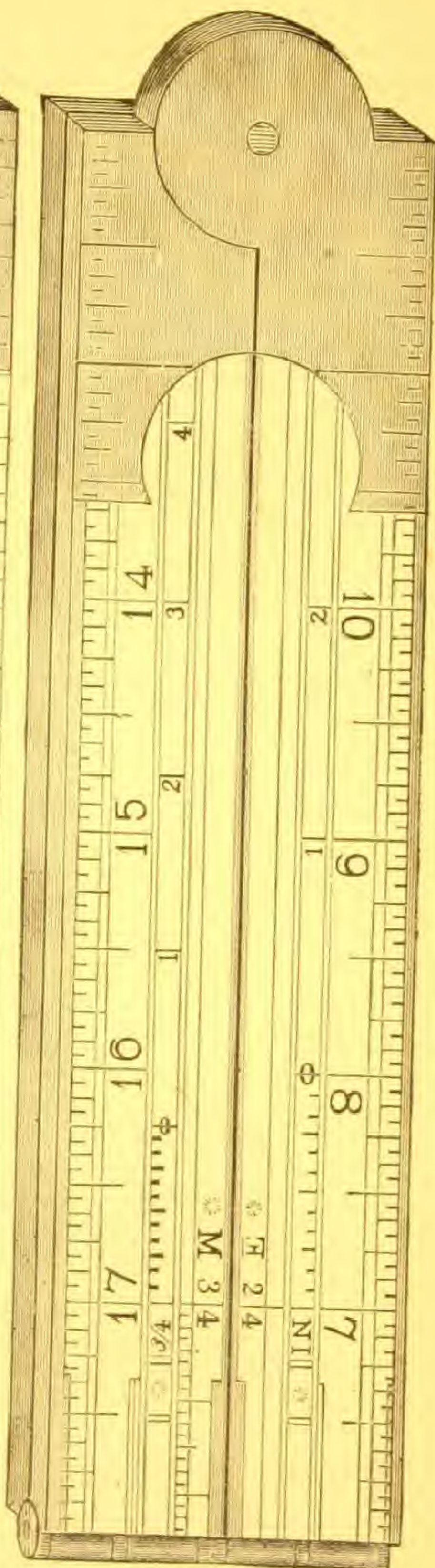
1106.	One Foot, four Fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths,	3.00
1107.	One Foot, four Fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths, with German silver edges, bound,	4.00
1108.	Two Feet, four Fold, boxwood, inside edges bevelled with Drafting Scales,	1.00



1108.

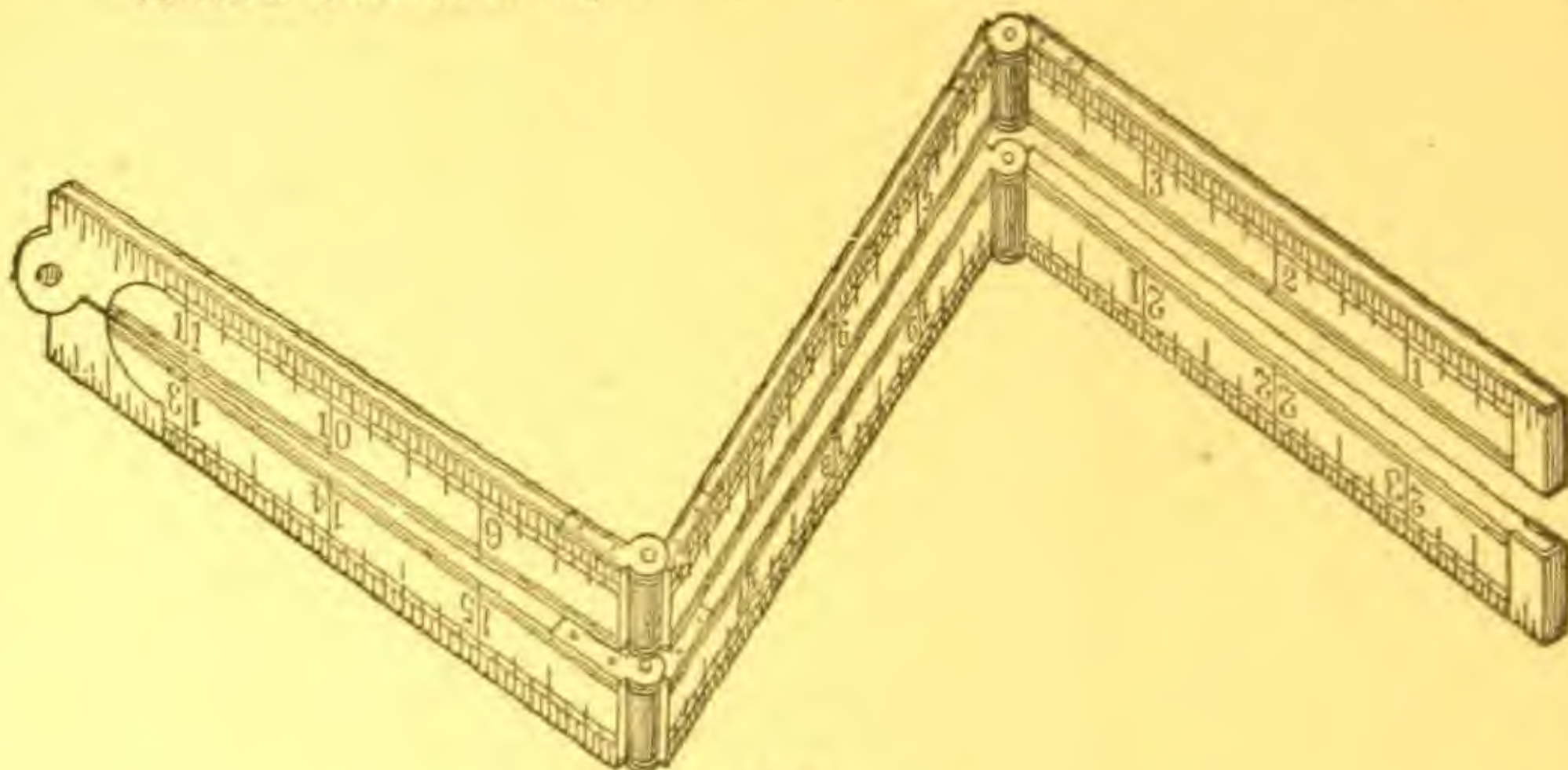


1111.



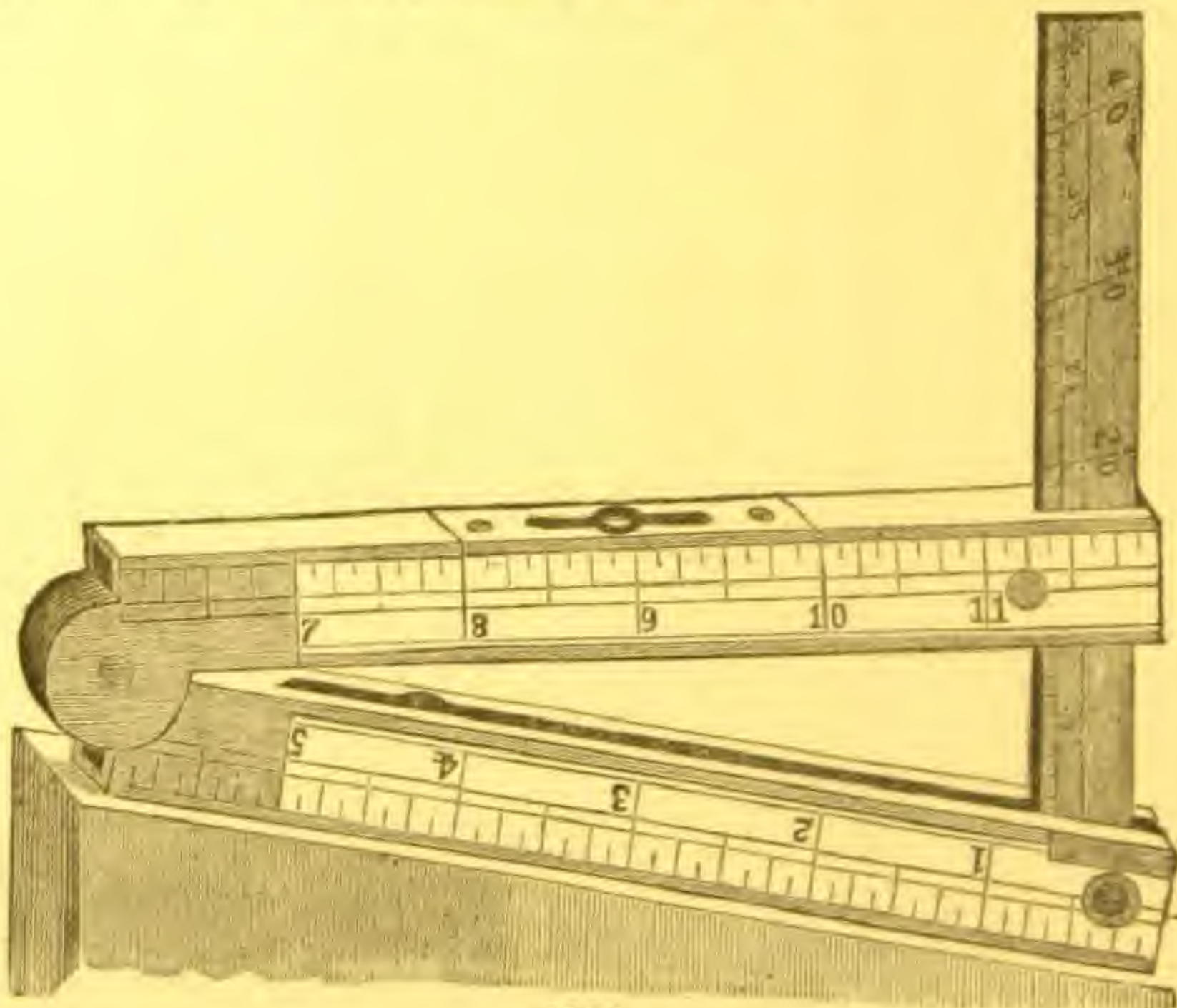
1112.

No.		PRICE.
1109.	Two Feet, four Fold, boxwood, . . .	\$0.30
1110.	Do. do. do. brass bound, with Drafting Scales, . .	1.00
1111.	Do. do. ivory, German silver mounted, with 8ths, 10ths, and 16ths inches, and $\frac{1}{4}$, $\frac{1}{8}$, $\frac{3}{4}$, and 1 inch Drafting Scales, . .	6.00
1112.	Two Feet, four Fold, ivory, same as No. 1111, German silver, bound, . .	7.50
1113.	Do. do. do. do. do. but extra broad and bound in German silver, . . .	9.00



1114.

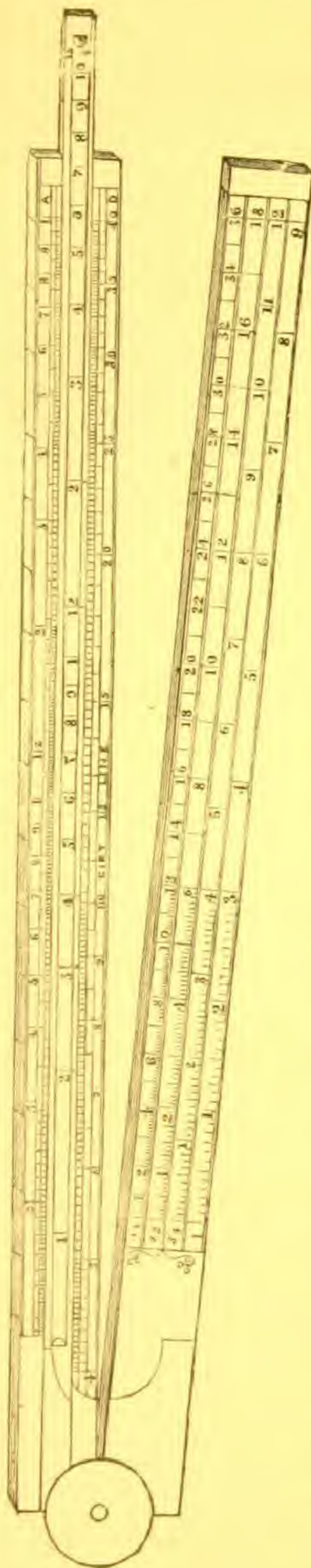
1114.	Two Feet, six Fold, boxwood, graduated 8ths, 10ths, 100ths, and 16ths, . .	1.25
1115.	Do do ivory, graduated 8ths, 10ths, and 16ths inches, . .	6.00



1116.

1116. Combination Rule, One Foot, two Fold, boxwood. This is the most convenient and useful pocket-rule ever made; it combines in itself a Carpenter's Rule, Spirit Level, Square Plumb, Bevel, Indicator, Brace, Scale, Draughting Scale of equal parts, T Square, Protractor, Right-angle Triangle, and with a straight edge can be used as a Parallel Ruler, all the parts of which, in their separate applications, are perfectly reliable,

An explanation and directions for use accompanies each of the Combination Rules. 3.00



1117. Two Feet, Two Folds, Boxwood Slide Rule, Gunter's, \$1.25
- 1117½. Treatise on the Gunter's Slide and Engineer's Rules, showing their utility, and containing full and complete instructions, enabling mechanics to make their own calculations. It is also particularly adapted to the use of persons having charge of cotton or woollen machinery, surveyors, and others. 200 pages bound in cloth.

Price \$1.00, net. Sent by mail, post-paid, on receipt of price.

ANEROID BAROMETERS.



1118.



1125.

Pocket Aneroid Barometers, with silvered enamelled Dials, in morocco cases.

No.						Price.
1118.	Plain Pocket Aneroid,	1 $\frac{3}{4}$	inches diameter,			\$15.50
1119.	Do	do.	2 $\frac{1}{2}$	do.		16.50
1120.	Do.	do.	1 $\frac{3}{4}$	do.	with Thermometer,	20.00
1121.	Do.	do.	2 $\frac{1}{2}$	do.	do.	21.00
1122.	Do.	do.	1 $\frac{3}{4}$	do.	open face, with Thermom.,	20.00
1123.	Do.	do.	2 $\frac{1}{2}$	do.	do. do.	21.00

Mountain Aneroid Barometers, compensated for Temperature, with silvered Dials, in morocco cases.

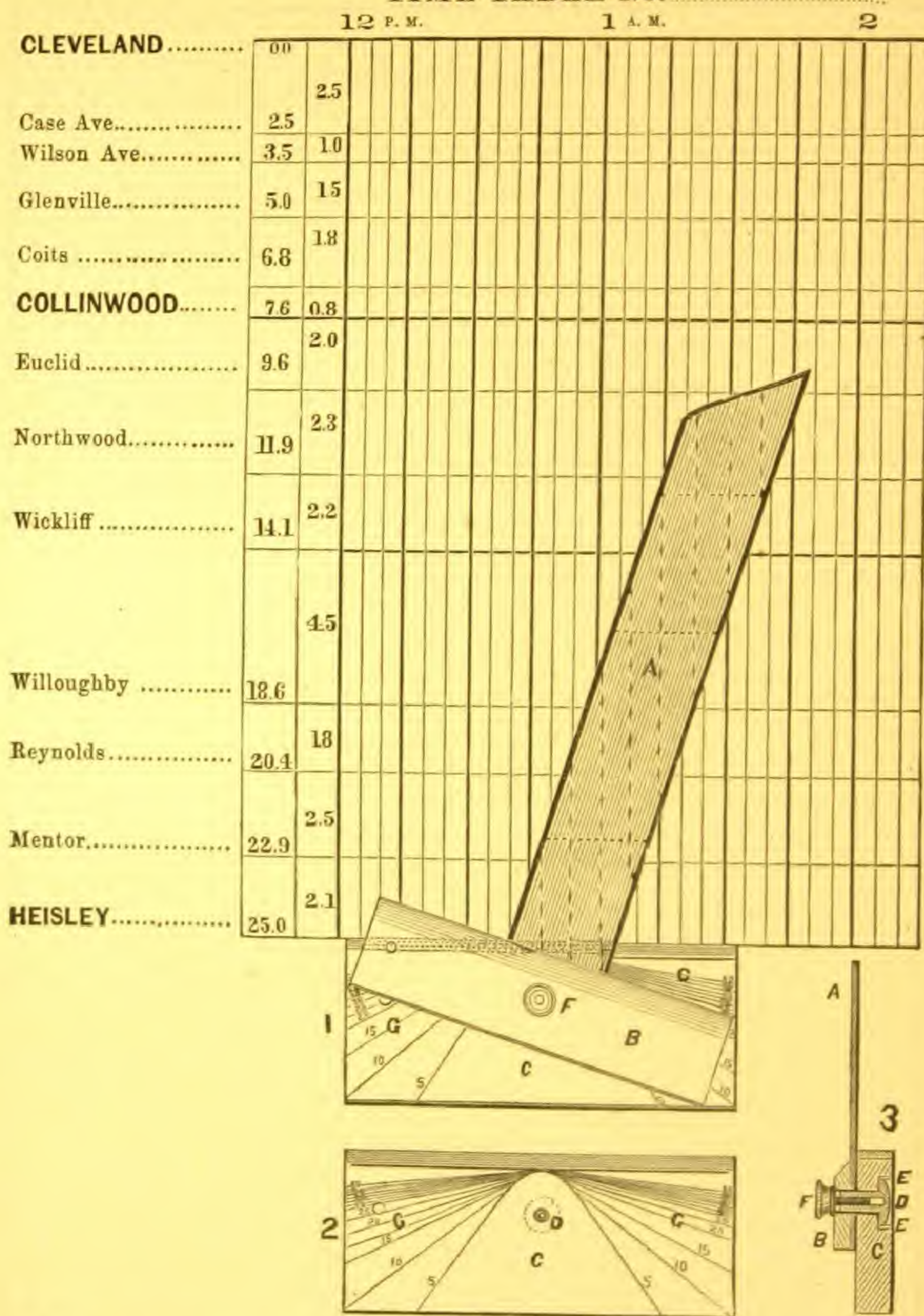
1125.	Pocket Aneroid,	1 $\frac{3}{4}$	inches diameter,	with Altitude Scale to 8000 feet,	18.00
1126.	Pocket Aneroid,	1 $\frac{3}{4}$	inches diameter,	with Altitude Scale to 8000 feet,	
			with Raised Ring and Thermometer,		20.00
1127.	Pocket Aneroid,	2 $\frac{1}{2}$	inches diameter,	with Altitude Scale to 8000 feet,	20.00
1128.	Pocket Aneroid,	2 $\frac{1}{2}$	inches diameter,	with Altitude Scale to 8000 feet,	
			with Raised Ring and Thermometer,		25.00
1129.	Pocket Aneroid,	1 $\frac{3}{4}$	inches diameter,	Altitude Scale to 15,000 feet,	25.00
1130.	Do.	2 $\frac{1}{2}$	do.	do. do. do.	26.50
1131.	Do.	1 $\frac{3}{4}$	do.	Raised Ring and Altitude Scale	
			to 20,000 feet,		27.00
1132.	Pocket Aneroid,	2 $\frac{1}{2}$	inches diameter,	Altitude Scale to 20,000 feet,	27.50

These Barometers are carefully tested under the receiver of an air-pump before shipment.

1133.	The Aneroid Barometer; How to Buy and How to Use it, with Altitude Tables,	.50
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Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.
ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
0	31.000	2400	28.387	4800	25.994	7200	23.803	9600	21.797
50	30.943	2450	28.335	4850	25.947	7250	23.760	9650	21.757
100	30.886	2500	28.283	4900	25.899	7300	23.716	9700	21.717
150	30.830	2550	28.231	4950	25.852	7350	23.673	9750	21.677
200	30.773	2600	28.180	5000	25.804	7400	23.629	9800	21.638
250	30.717	2650	28.128	5050	25.757	7450	23.586	9850	21.598
300	30.661	2700	28.076	5100	25.710	7500	23.543	9900	21.558
350	30.604	2750	28.025	5150	25.663	7550	23.500	9950	21.519
400	30.548	2800	27.973	5200	25.616	7600	23.457	10000	21.479
450	30.492	2850	27.922	5250	25.569	7650	23.414	10050	21.440
500	30.436	2900	27.871	5300	25.522	7700	23.371	10100	21.401
550	30.381	2950	27.820	5350	25.475	7750	23.328	10150	21.361
600	30.325	3000	27.769	5400	25.428	7800	23.285	10200	21.322
650	30.269	3050	27.718	5450	25.382	7850	23.242	10250	21.283
700	30.214	3100	27.667	5500	25.335	7900	23.200	10300	21.244
750	30.159	3150	27.616	5550	25.289	7950	23.157	10350	21.205
800	30.103	3200	27.566	5600	25.242	8000	23.115	10400	21.166
850	30.048	3250	27.515	5650	25.196	8050	23.072	10450	21.128
900	29.993	3300	27.465	5700	25.150	8100	23.030	10500	21.089
950	29.938	3350	27.415	5750	25.104	8150	22.988	10550	21.050
1000	29.883	3400	27.364	5800	25.058	8200	22.946	10600	21.012
1050	29.828	3450	27.314	5850	25.012	8250	22.904	10650	20.973
1100	29.774	3500	27.264	5900	24.966	8300	22.862	10700	20.935
1150	29.719	3550	27.214	5950	24.920	8350	22.820	10750	20.896
1200	29.665	3600	27.164	6000	24.875	8400	22.778	10800	20.858
1250	29.610	3650	27.115	6050	24.829	8450	22.736	10850	20.820
1300	29.556	3700	27.065	6100	24.784	8500	22.695	10900	20.782
1350	29.502	3750	27.015	6150	24.738	8550	22.653	10950	20.744
1400	29.448	3800	26.966	6200	24.693	8600	22.611	11000	20.706
1450	29.394	3850	26.916	6250	24.648	8650	22.570	11050	20.668
1500	29.340	3900	26.867	6300	24.602	8700	22.529	11100	20.630
1550	29.286	3950	26.818	6350	24.557	8750	22.487	11150	20.592
1600	29.233	4000	26.769	6400	24.512	8800	22.446	11200	20.554
1650	29.179	4050	26.720	6450	24.467	8850	22.405	11250	20.517
1700	29.126	4100	26.671	6500	24.423	8900	22.364	11300	20.479
1750	29.072	4150	26.622	6550	24.378	8950	22.323	11350	20.441
1800	29.019	4200	26.573	6600	24.333	9000	22.282	11400	20.404
1850	28.966	4250	26.524	6650	24.288	9050	22.241	11450	20.367
1900	28.913	4300	26.476	6700	24.244	9100	22.200	11500	20.329
1950	28.860	4350	26.427	6750	24.200	9150	22.160	11550	20.292
2000	28.807	4400	26.379	6800	24.155	9200	22.119	11600	20.255
2050	28.754	4450	26.330	6850	24.111	9250	22.079	11650	20.218
2100	28.701	4500	26.282	6900	24.067	9300	22.038	11700	20.181
2150	28.649	4550	26.234	6950	24.023	9350	21.998	11750	20.144
2200	28.596	4600	26.186	7000	23.979	9400	21.957	11800	20.107
2250	28.544	4650	26.138	7050	23.935	9450	21.917	11850	20.070
2300	28.491	4700	26.090	7100	23.891	9500	21.877	11900	20.033
2350	28.439	4750	26.042	7150	23.847	9550	21.837	11950	19.996
2400	28.387	4800	25.994	7200	23.803	9600	21.797	12000	19.959

TIME TABLE No.



1135.

The above cut represents, Fig. 1, the "Speed Protractor," as set at a speed angle of 25 miles per hour, and part of a Chart. Fig. 2 represents the lower head, C, with the speed scale, G, engraved on it. Fig. 3 is a cross section of the lower head, C, the upper and movable head, B, and part of the blade, A. The blade, A, is 42 inches long, made of hard rubber and backed with mahogany wood. The two heads, B and C, are made of steam-dried satin wood and faced with ebony. Dimensions of lower head, C, 4x15 inches; of upper head, B, 2½x14½ inches. D, E, F, Fig. 3, represent the fixed brass pivot and thumbscrew, for setting the instrument at any required speed.

1135. Hill's Railroad Time-Charts.

The principal features of the Charts are:

1. The positively *mathematical correctness* of the spacing.
2. The *ease* with which the 5 minutes, half hour, and hour lines can be distinguished, as well as their perfect *clearness* and *cleanness*.
3. Their *enormous size* (28 x 50), admitting of larger hour-spaces than any chart at present in use.
4. The *excellence* of the *paper* on which they are printed, as well as its *peculiar tint*, rendering it peculiarly fit for night work, while its cardboard-like texture obviates the necessity for dampening and stretching, and the consequent distortion of the diagram.
5. Their *cheapness*, which enables us to furnish them to railroads in smaller quantities, and at a lower price, than they could be obtained by lithographic or any other process.

The "*Speed Protractor*," which is generally used with the Charts, needs hardly any recommendation. The *simplicity* of its *construction*, the *care* bestowed in its *manufacture*, its greater *accuracy* than that of the semicircular angle protractor, and its *low price*, speak for themselves.

The price of the Charts, without name of stations, station lines, and heading, is \$12 per quire; complete and ready for train-plotting, the scale of prices is as follows, viz.:

50 Sheets,	\$50.00
100 do.	80.00
150 do.	110.00
200 do.	140.00
Speed Protractor,	10.00

In favoring us with an order for complete Charts, please send list of *stations* with intermediate *distances*, and *underscore* such stations as you may desire to have printed in *heavy type* on account of their importance.

The following is an extract from a letter of Mr. James Tillinghast, General Superintendent of the New York Central and Hudson River Railroad, to whose judgment Mr. Hill submitted both Charts and Protractor:

"NEW YORK CENTRAL AND HUDSON RIVER RAILROAD, }
Gen'l Supt. Office, Albany, N. Y., Jan. 15, 1876. }

"ALBERT HILL, Esq.

"*Dear Sir:*—I am in receipt of yours of the 14th inst., with sample of diagram of Chart sheets. . . . I have not found any better plan to secure accuracy in forming the basis or proof of time tables, for the reason that it presents to the eye, in a clear, condensed form, all the trains the schedule is to cover, and in such manner that the station figures are *accurately* indicated, and from which the figures for the printed form can be *readily copied*.

"Your plan of '*Speed Protractor*' is the *best* I have seen, and will be very useful in connection with the Charts, and I have no doubt that, with the facilities you mention for the production of charts *so accurately lined* as your process will produce, you will be able to secure orders.

"Yours truly,

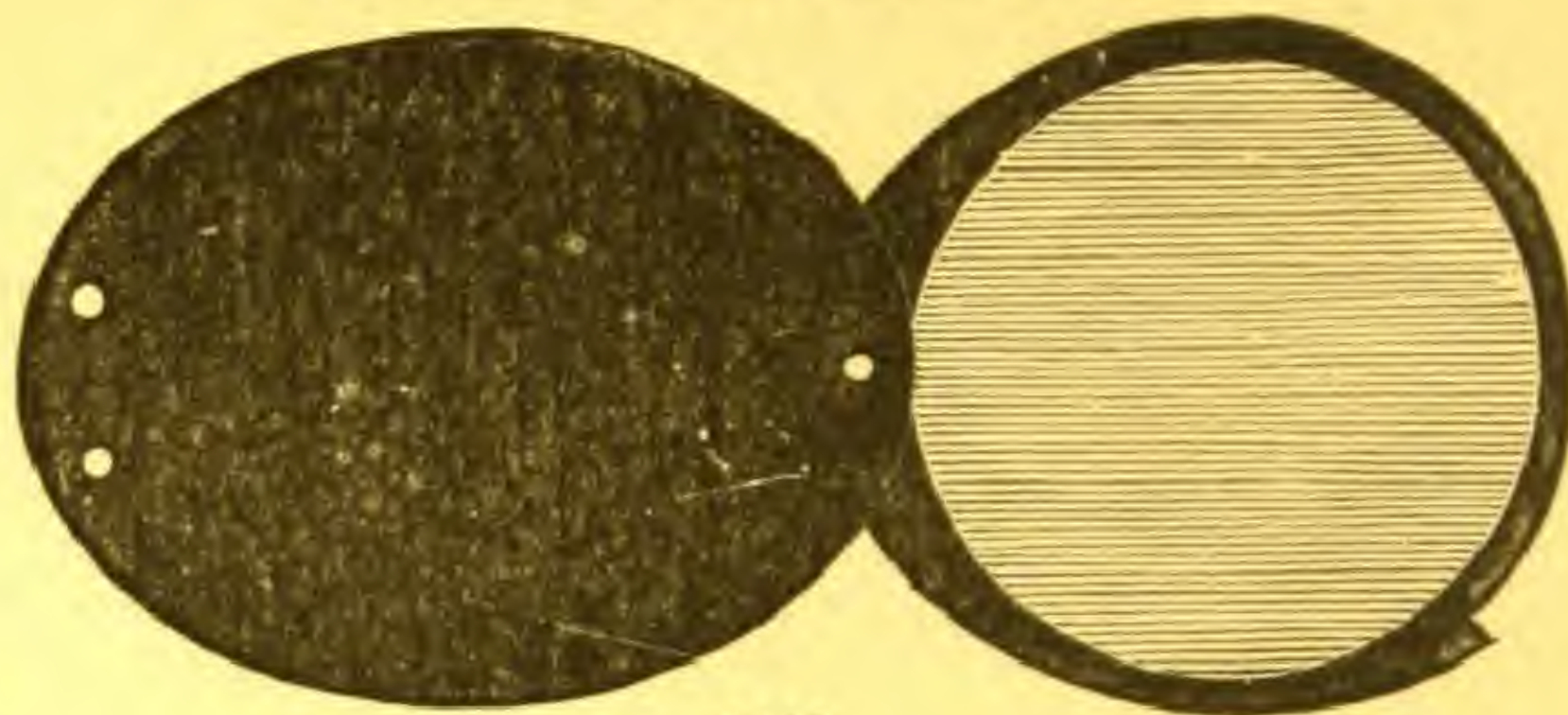
"JAMES TILLINGHAST."

The following is a list of some of the principal railroad companies by whom these Charts have so far been adopted:

Pennsylvania Railroad,
Central Railroad of New Jersey,
Lake Shore and Michigan Southern Railroad,
Toledo, Wabash and Western Railway,
Cleveland, Tuscarawas and Wheeling Railroad, etc., etc.

It desired, we will send by mail, postage paid, a Chart of any of the above-named roads, as a sample.

POCKET MAGNIFYING GLASSES.



1138.

No.									PRICE.
1136.	Hard Rubber case and frame, round form, 1 double convex lens, $\frac{3}{4}$ in. diam.								\$0.50
1137.	Do.	do.	do.	do.	1	do.	1	do.	.75
1138.	Do.	do.	do.	do.	1	do.	$1\frac{1}{4}$	do.	1.00
1139.	Do.	do.	do.	do.	1	do.	$1\frac{3}{4}$	do.	1.50
1140.	Do.	do.	do.	do.	2	do.	1	do.	1.25
1141.	Do.	do.	do.	do.	2	do.	$1\frac{1}{4}$	do.	2.00
1142.	Do.	do.	do.	bellows form,	1	do.	$1\frac{3}{4}$	do.	.75
1143.	Do.	do.	do.	do.	1	do.	1	do.	1.00
1144.	Horn case, German silver frame,	do.			1	do.	$\frac{3}{4}$	do.	1.00
1145.	Hard Rubber case and frame,	do.			2	do.	$\frac{3}{4}$	do.	1.00
1146.	Do.	do.	do.	do.	2	do.	1	do.	1.25
1147.	Horn case, German silver frame,	do.			2	do.	$\frac{3}{4}$	do.	1.50
1148.	Hard Rubber case and frame,	do.			3	do.	$\frac{3}{4}$	do.	1.50
1149.	Do.	do.	do.	do.	3	do.		do.	1.75
1150.	Horn case, German silver frame,	do.			3	do.	$\frac{3}{4}$	do.	2.00

EXTRAS TO TRANSITS.

Vertical Circle, $3\frac{1}{2}$ inch diameter, vernier reading to five minutes,	8.50
Do. $4\frac{1}{2}$ do. do. single do.	14.50
Vertical Arc, 6 inch diameter, divided on silver, with vernier, movable by tangent screw, reading to 30 seconds,	20.00
Clamp and Tangent Movement to Axis of Telescope,	8.00
Level on Telescope, with ground bubble and scale,	15.00
Rack and Pinion Movement to Eye-Glass,	5.00
Sights on Telescope, with folding joints,	9.00
Sights on Standards at right angles to Telescope,	9.00
Jointed Tripod Legs, for Mining Engineering,	6.50
Adjustable Stadia Hairs for Telescope,	10.00
Plated Reflector for Graduations,	4.00
Plated Reflector for Cross Wires,	4.00

EXTRAS TO COMPASSES.

Jacob Staff Mountings, brass head,	5.00
Jacob Staff Mountings, steel shoe,	.75
Needle and Cap.	3.50
Centre Pin,	1.00
Compass Glass,	1.00
Chamois Skin,	.50

CHAPTER XIV.

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ALLEN. Cottage Building. By C. B. Allen. (Weale's series,)	60
ALLEN. Rural Architecture; being a Complete Description of Farm-Houses, Cottages and Out-Buildings. By L. F. Allen. 12mo,	1 50
ARCHITECT'S (The) Guide; or, Office and Pocket Companion, for Architects, Engineers, &c. By W. D. Haskoll, G. Rennie, F. Rogers and P. Thompson. 1 vol. 16mo, cloth,	1 50
ATWOOD'S Country and Suburban Residences,	1 50
——— Modern American Homesteads. 46 plates,	3 50
AUSTIN. A Practical Treatise on Calcareous and Hydraulic Limes and Cements. By J. G. Austin. 1 vol. 12mo, cloth. London, 1862,	2 00
BARNARD. School Architecture. By Henry Barnard. 3d edition. 1 vol. 8vo, cloth. New York, 1849,	2 00
BAUMAN. The Art of Preparing Foundations for all kinds of Buildings. By Frederick Bauman,	75
BELL. Carpentry Made Easy. By W. F. Bell. 1 vol. 8vo,	5 00
BICKNELL'S VILLAGE BUILDER. Elevations and Plans for Cottages, Villas, Suburban Residences, Farm-houses, Stables, and Carriage-houses, Stone Fronts, School-houses, Churches, Court-houses, and a Model Jail. 4to. New edition, with supplement,	12 00
——— Detail Cottage and Constructive Architecture,	10 00
BLENKARN. Practical Specifications of Works executed in Architecture, &c. By J. Blenkarn. 1 vol. 8vo. London, 1865,	9 00
BOWLER. Chapel and Church Architecture, with Designs for Parsonages. By Rev. G. Bowler. Folio, illustrated,	10 00
BROOKS. Erection of Dwelling Houses, with Specifications, Quantities of Materials, &c. 27 plates. By S. H. Brooks. (Weale's series,)	1 00
——— Modern Architecture; being a series of Designs for Street Elevations, Shop Fronts, Buildings adapted for Towns, with Specifications, &c. By S. H. Brooks. 1 vol. quarto. London,	21 00
——— New Designs for Chimney Pieces, with Elevations, Sections, Profiles, and Plans. By S. H. Brooks. 6 parts, royal 4to. London,	15 00
BULLOCK. The American Cottage Builder. By J. Bullock. 1 vol. 8vo, cloth. Philadelphia, 1869,	3 50
——— The Rudiments of Architecture and Building. By J. Bullock. 8vo, cloth,	3 50
BURN. Model Designs for Mansions, Villas, Cottage Residences, Park Entrances and Lodges, being Plans, Elevations, Sections, Detailed Drawings, and Descriptive Specifications. Arranged by Robert Scott Burn. 1 vol. quarto, half morocco,	15 00
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BURY. Styles of Architecture. By T. Bury. (Weale's edition,)	80
BUTLER. Ventilation of Buildings. By W. F. Butler. With illustrations.	50

CAMPIN. On the Construction of Iron Roofs, a Theoretical and Practical Treatise. By Francis Campin, C. E. With wood-cuts and plates of roofs lately executed. Small 4to, cloth. New York, 1868,	\$2 00
CARPENTERS' and Builders' Guide,	1 00
CLEVELAND AND BACKUS. Cottage and Farm Architecture,	4 00
CROFF. Model Suburban Architecture, embodying Designs for Dwellings of Moderate Cost, together with elaborate and extensive Villas, &c., &c. By C. B. Croff, Architect. 1 vol. quarto. 1870,	5 00
CROFT'S Designs for Front Entrance Doors. 22 large plates,	5 00
CUMMINS AND MILLER. Designs for Street Fronts, Suburban Houses and Cottages. By M. F. Cummins and C. C. Miller, Architects. 1 vol, large 4to, cloth. Troy, 1868,	10 00
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DEMANET. Guide Pratique du Constructeur Maconnerie. By A. Demanet. 1 vol. 12mo, paper, and 1 vol. plates. Paris, 1864,	2 00
DENTON. The Farm Homesteads of England: a collection of plans of the most approved specimens of Farm Architecture. Edited by J. Bailey Denton, C.E. 2d edition. 4to, cloth. London, 1865,	25 00
DESIGNS (Original) for English Cottages, containing Views, Elevations, Plans and all Detail Drawings, &c., &c. By a Practical Surveyor and Builder. 1 vol. quarto. London, 1866,	10 50
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DOWNING. Cottage Residences. By A. J. Downing. 4to, cloth,	6 00
——— Hints to Persons about Building in the Country. By A. J. Downing. New York, 1868,	2 00
——— Architecture of Country Houses. By A. J. Downing. 8vo, cloth,	6 00
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EASSIE. Healthy Houses. A Hand-Book of the History, Defects, and Remedies of Drainage, Ventilation, Warming, and Kindred Subjects. With 300 illustrations. By William Eassie, C. E. 12mo, cloth. New York, 1872,	1 00

ESTERBROOK AND MONCKTON. American Stair-Builder. By W. P. Esterbrook and J. H. Monckton. Illustrated. 4to,	\$8 00
FAIRBAIRN. The Application of Cast and Wrought Iron to Building Purposes. By William Fairbairn, C. E. 3d edition. New York, 1864. Illustrated. 1 vol. 8vo, cloth,	2 00
FIELD. City Architecture; or Designs for Dwelling-Houses, Stores, Hotels, &c. In 20 plates. With Descriptions and an Essay on the Principles of Design. By M. Field. 1 vol. 8vo, cloth. New York, 1854,	3 00
FRANCIS. On the Strength of Cast Iron Pillars. With Tables for the Use of Engineers, Architects, and Builders. By J. B. Francis, Civil Engineer. 1 vol. 8vo, cloth. New York, 1865,	2 00
GARBETT. Principles of Design. By E. L. Garbett. (Weale's series,)	80
HALLETT'S Builder's Specifications,	1 75
——— Builder's Contracts,	10
HARNEY'S Barns, Out-Buildings, and Fences. 200 designs. By G. E. Harney,	10 00
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JACQUES. The House: A Manual of Rural Architecture, or How to Build Country Houses and Out-Buildings. With numerous Original Plans. By D. H. Jacques. Revised edition. 1 vol. 12mo, cloth,	1 50
LAXTON. Bricklayers' Tables. By Henry Laxton, C. E. 1 vol. 4to. London, 1869,	2 50
LEEDS. Orders of Architecture. By W. H. Leeds. (Weale's series,)	60
LOTH. The Practical Stair-Builder. A complete Treatise on the Art of Building Stairs and Hand-Rails. Illustrated with 30 plates. By C. E. Loth. 1 vol. 4to, cloth. Troy, 1868,	10 00
MITCHELL. A Rudimentary Manual of Architecture, being a History and Explanation of the Principal Styles of European Architecture, Ancient, Mediæval, and Renaissance, &c., &c., to which is appended a Dictionary of Terms. By Thomas Mitchell. 1 vol. 12mo, cloth, illustrated. London, 1870,	5 00
——— Stepping-Stones to Architecture, consisting of a Series of Questions and Answers explaining the Principles of Architecture. By Thomas Mitchell. 1 vol. London, 1869,	50
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CHAPTER XV.

THE USE OF MATHEMATICAL INSTRUMENTS.

In the foregoing Catalogue we have divided the sets of Drawing Instruments into three classes, viz.: Brass, Fine German Silver, and Extra Fine Swiss. The brass instruments are intended for schools; the fine German silver and the extra fine Swiss instruments for the practical draughtsman.

Without the aid of some drawing instrument, a student cannot obtain a thorough knowledge of Geometry, Trigonometry or Surveying; but, as very few who go over these branches in youth ever make any practical use of them in after life, it is not necessary that the drawing instruments, which are furnished to schools, should be any finer in finish and quality than is sufficient for a clear demonstration of the problems. The sets of brass drawing instruments are equal to all the wants of a young student.

But to the practical draughtsman, his drawing instruments are next to his head and his hands, and they must be of the best material, well and accurately finished. He uses them every day, and all day, and if they are not perfectly correct, the loss and delay occasioned by them, in one instance, will be much greater than the cost of a good set of instruments, which can be used his lifetime.

The fine German silver drawing instruments meet the wants of the practical man.

The extra fine Swiss drawing instruments are more nicely finished than the fine German silver; the metal of which they are made resembles more closely pure silver; they are more substantial in their construction, and consequently more durable. As a general rule, draughtsmen give the preference to the extra fine Swiss drawing instruments.

The fewest drawing instruments a mechanical or architectural draughtsman can possibly perform his work with are the following, viz.:—

- A pair of Plain Dividers, 5 or 6 inches long, as No. 66.
- A pair of Dividers, 5 or 6 inches long, with changeable points, as No. 73.
- A pair of Small Spacing Dividers, as No. 78.
- A Spring Bow Pen, as No. 81.
- A Spring Bow Pencil, as No. 84.
- A Drawing Pen, as No. 87.
- A Drafting Scale.
- A T Square.
- A Triangle.
- A Drawing Board.
- An Irregular Curve.
- Half dozen Fastening Tacks.

An engineer or surveyor can perform his work with fewer drawing instruments. The following list will suffice:—

- A pair of Plain Dividers, 5 or 6 inches long, as No. 66.
- A pair of Dividers, 5 or 6 inches long, with changeable points, as No. 73.
- A Drawing Pen, and a Drafting Scale.

It must be borne in mind, that the above are lists of instruments which are absolutely necessary for the architect and the engineer to have, and without which he cannot follow his profession; but there are many other instruments mentioned in the Catalogue which can be added, and by their aid the work can be much simplified, and more speedily accomplished.

Having made these general remarks we will now proceed to describe each of the drawing instruments—their use, and how to use them.

THE PLAIN DIVIDERS.

This instrument consists of two legs, the upper half of which are made of brass or German silver, and the lower half, or points, of tempered steel. In the fine instruments, the joints about which the legs move should be framed of the two different metals—German silver and steel; by this arrangement the wear is much diminished, and greater uniformity and smoothness of motion is obtained. If this uniformity and smoothness be wanting, it is extremely difficult to set the legs quickly apart, at a desired distance; for being opened and closed by the fingers of one hand, if the joint is not good they will move by fits and starts, and either go beyond or stop short of the point; but when they move evenly the pressure can be so applied as to open the legs at once to the exact distance, and the joint must be sufficiently tight to hold them in this position, and not permit them to deviate from it, in consequence of a small amount of pressure which is inseparable from their use. The joints of the dividers are tightened or loosened by inserting the two steel points of the key, into the two small holes on one side of the head of the dividers, and turning from one to tighten it, and in the opposite direction to loosen it.

THE HAIR-SPRING DIVIDERS.

When greater accuracy in setting the legs apart is required, than can be obtained by the joint alone, a draughtsman uses the Hair-spring Dividers. The peculiarity of these dividers is, that the upper part of one of the steel points is formed into a bent spring, which being fastened into the German silver portion of the leg, near the joint of the dividers, is made to fit into a groove, cut the whole length of the German silver part of the leg, into which groove this spring can be drawn, or let slip out, by turning the screw on the middle of that side of the dividers.



No. 69 represents the Hair-spring Dividers when shut up; No. 69a represents the same dividers with the spring let a little out of the groove, by loosening the screw.

To take a distance with the Hair-spring Dividers they must be opened as nearly as possible to the required distance; set the leg without spring on the point from which the distance is to be taken, and make the point of the other leg coincide accurately with the end of the required distance, by loosening or tightening the screw on the side of the spring leg.

**THE STEEL SPRING SPACING DIVIDERS.**

In mechanical and architectural drawings, it frequently occurs that a large number of very small equal distances are to be set off, not only at one time, but repeatedly, upon the same drawing; for this purpose the ordinary dividers are too large and inconvenient to handle rapidly, and having nothing but the joint to hold them in their position, are liable to get their extension altered. For such work there is used a pair of very delicate dividers, made altogether of steel, the two legs of which are united at the top by an arched spring, and drawn together or opened by the screw in the middle. On the top of the arched spring an ivory or German silver handle is attached, by which the instrument can be quickly turned over and over, when used in spacing off a number of equal distances. The size of the spacing dividers mostly used are three inches long, with the legs delicately rounded from the regulating screw to the points. The advantages gained by these spacing dividers are, greater nicety and accuracy of adjustment, and no liability of accidental change when once adjusted.

**DIVIDERS WITH CHANGEABLE POINTS.**

If an arc or circle is to be described faintly, merely as a guide for the termination of other lines, the steel points are generally sufficient for the purpose; but when arcs and circles are to be drawn permanently, and to show clearly, one point of the dividers must carry either a lead pencil or ink. To accomplish this the steel parts of the legs of the dividers are made so that they can be taken out and replaced by pieces, either for pencil or ink; the small screws in the middle of the legs retain the points firmly in their places. The cut 152 illustrates a set with a pen-point, *a*, a pencil-point, *b*, a dotting-point, *c*, a needle-point, *d*, and a lengthening-bar, *e*.

The pen-point, *a*, consists of two steel blades, so bent that when the points nearly touch each other there is space above for holding ink; the two blades are drawn together or put apart by a regulating screw in the middle. One of the steel blades works upon a joint at its upper end, so that the ink can be thoroughly cleaned off when the pen-point is to be put away, and thereby preventing its being injured by rusting.

To use the pen-point, after securing it tightly in the proper side of the dividers, the ink is put in between the blades by a common writing pen, which should be drawn down and out between the points, then the points of the blades are brought to the proper distance apart for making the line—the closer the points are together the finer the line; the point of the pen must always be as near at right angles to the paper as possible; a joint is made in the German silver part of the point, to regulate the proper inclination.

The pencil-point, *b*, is made of German silver, the lower part of which is formed into a tube; a lead-pencil is placed in this tube, and held tightly by the clamp-screw on the side.

The dotting-point, *c*, is exactly like the pen-point, with the addition of a small toothed wheel, which revolves between the points of the blades, each tooth leaving a dot wherever it touches the paper; and thus, instead of a continuous ink line, a line of dots is made; such lines are meant to illustrate the course of an imaginary line or arc.

The needle-point, *d*, is made similar to the pencil-point; the tube on the lower end is only large enough to take a fine needle, which is held securely in its place by the thumb screw on the side. The needle-point is put in place of one of the steel legs of the dividers, when a number of arcs are to be made from the same centre; it does not deface the drawing by large holes, as the ordinary steel points would. The pen, pencil, dotting and needle-points are all made with a joint near their upper end, in order to bring the points at right angles with the paper.

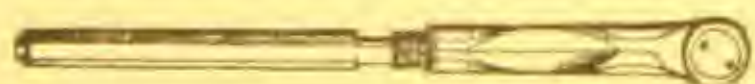
The lengthening-bar, *e*, is made wholly of German silver, one end of which fits in place of one of the steel legs of the dividers, and the other end has a socket and binding-screw, for receiving and holding the pen, pencil, or dotting-point. It is used when larger circles or arcs are to be drawn than can be made by simply extending the legs of the dividers. The side of the dividers into which the needle-point fits, also the steel point, and the needle-point, are marked on the inside with small dots, to indicate where these points are to be put, when used; those points which are not marked thus, are to be used on the other side of the dividers.

In a large drawing there is always a great amount of finer detail, which can be executed with more accuracy and ease by a set of small instruments. The cut, No. 72, illustrates a set one-half the size of No. 73, but constructed and used in the same manner. It is not provided with the dotting-pen and lengthening-bar. Above the joints of the dividers a handle is attached, by which it can be held and used with more facility than by taking them by the joints, as is done with the large set.

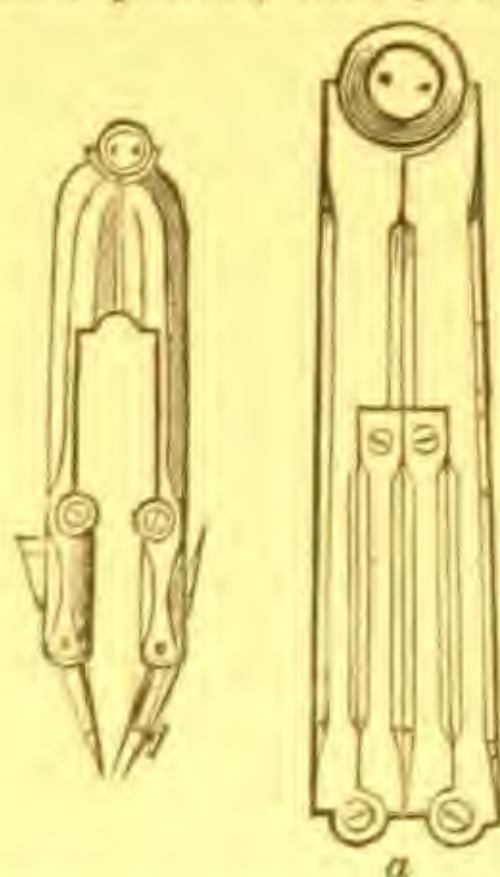
No. 158 represents a set of instruments similar to No. 72, but has a spring over the joints, and a regulating screw in the middle of the legs, by which the points can be opened or drawn together with great nicety and exactness. The handle is of ivory and much longer than that of No. 72. With No. 158 there are two pen-points; when they are both substituted in place of the steel points, an instrument for drawing parallel lines is obtained; or, in other words, a railroad drawing-pen, the use of which see cut No. 92, page 10.

POCKET DIVIDERS.

It is oftentimes found convenient by the engineer and surveyor to have a pair of dividers for use in the field, which can be carried with safety in the pocket; these are called pocket dividers; the simplest form is a pair of ordinary plain dividers, 5 or 6 inches long, having a German silver sheath, with a blunt point, which screws over the steel points. No. 74 represents this form.



Another form of the pocket dividers is so constructed as to include points for pen and pencil, and yet, all contained in a very small compass. No. 79 represents this



form. The legs of these dividers are jointed together same as the ordinary plain dividers, but each of them is again jointed about the middle, so that the ends can be folded in towards the upper joint; a deep slot is made in each leg; from their ends, and running almost up to the middle joints in these slots, the steel points are neatly adjusted on pivots; the opposite end of one steel point is finished into a drawing-pen, and the opposite end of the other into a tube for holding the lead-pencil; thus, when the steel points are revolved, either a pencil or pen-point is presented. When not in use, the legs are folded in at the middle joint; the inner sides of the legs of the dividers are filed out to receive the points, so that when they are not in use every delicate part is protected from injury. It will be readily seen, that with the legs of the dividers fully extended, and both of the sharp steel points presented to the paper, that we have an ordinary pair of dividers; by revolving the point which has the

drawing-pen on the opposite end we will then have a pair of dividers with pen-point for describing ink circles; but if we should revolve the other steel point, we should then have a pair of dividers with pencil-point for describing arcs and circles with the lead pencil. Fig. a represents No. 79 drawn on a larger scale, and folded for the pocket.

Another form of pocket dividers is represented by No. 179. The legs are jointed together the same as an ordinary pair of dividers, but instead of being solid they are drilled out from the end almost up to the joint. The steel points, instead of having the pen and pencil-points at their opposite ends, as in No. 79, are jointed in the middle.



When not in use the pen and pencil-points are slipped into the holes in the legs of the dividers, and the steel point bent up against the inside, as represented in the cut. When a pair of plain dividers is wanted, the steel points are turned out straight with the legs of the dividers. When a pair of dividers with pen-point is wanted, the pen is withdrawn from the dividers and the steel point slipped into the hole in the leg; and in the same way the pencil-point takes the place of its steel point, when a lead-pencil circle is to be drawn. For making very small circles, either of ink or lead-pencil, the points can be withdrawn from the legs of the dividers, and used independent of them, as the steel point, with pen-point, of itself is a bow pen, and the steel point, with lead-pencil holder, is a bow pencil.

THREE-LEGGED DIVIDERS.

Or, Triangular Compasses, are used for transferring triangular areas from one drawing to another. It is an ordinary pair of plain dividers, with a third leg attached by a universal joint to the face of their joint, so that whatever may happen to be the form of the triangle the legs can be turned to bring each of the points upon one of the angles.



To use the triangular dividers, open the main legs to take in the base then open and turn the third leg and bring it upon the angle above the base; the legs of the dividers are now set to the form of the triangle, which can be transferred correctly to any other drawing.

BISECTING DIVIDERS.

Or, Wholes and Halves, is a pair of ordinary dividers, with the legs continued beyond the joint; the legs, above the joint, being made exactly one-half the length of those



below, therefore, when the longer legs are extended to any two points, the distance between the points of the shorter legs will be one-half of that between the longer points. This instrument is very useful when a drawing is to be reduced one-

half, or enlarged double the size of a given copy. If one of the points should get broken it will be necessary to alter all the other points, and keep up the proportion between the short and long legs.

PROPORTIONAL DIVIDERS.

This instrument is designed for dividing a line into any number of equal parts; for describing regular polygons in given circles; for reducing or enlarging the area of a drawing, and also for taking the square and cube root of numbers.

The bodies of the legs of these dividers are made of a flat piece of German silver, or brass, with a rectangular opening cut in each, nearly the whole length; the ends of the legs are armed with steel points; the longest two are four or five times the length of the shortest ones. The legs are put together with the rectangular openings exactly opposite each other, and retained in their place by clamp plates and a thumb-screw, which can be moved up and down the opening, and made tight at any desired point; these clamp plates and thumb-screw constitute the joint of the dividers, upon which the legs are opened, and it is easy to perceive that if this joint is exactly half way between the extremity of the points, the two ends will open to the same distance; but if the joint is moved nearer one end, the openings of the points will bear the same proportion to each other as the longer does to the shorter part.

The cheaper form of these dividers (No. 23, page 4,) have but one set of graduations, by which lines only can be subdivided;—the proportions are $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$; that is, if the line across one of the clamp plates is made to come opposite either of the divisions on the leg, the two ends of the dividers will open in that proportion.

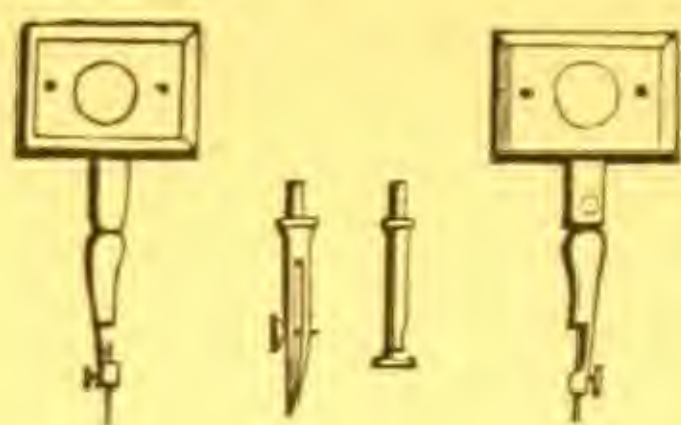
The best proportional dividers (Nos. 76 & 159, pp. 9 and 23,) have one side of one of the legs graduated for dividing lines into $\frac{1}{12}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{6}$, $\frac{5}{7}$, $\frac{6}{7}$, $\frac{7}{8}$, $\frac{8}{9}$, $\frac{9}{10}$, and the other side of the leg is graduated for inscribing regular polygons of 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 sides in given circles. To use the line of polygons, bring the line across the clamp plate to coincide with the graduation which is marked with the number that the polygons is to have sides, then open the dividers, and make the long steel points take in the radius of the circle, then the distance between the small points will be the length of one side of the required polygon. As very few proportional dividers are made with the graduations for enlarging the area of a drawing, and those for taking the cube and square root of numbers, on account of their practical use being very limited and quite complicated, we have concluded to omit their description, and refer those who wish to be informed upon the use of those graduations to Heather's Treatise on Mathematical Instruments, page 5.

The joint of most of the proportional dividers is slipped along the rectangular opening by the hand; but it is frequently quite difficult to bring it exactly to the right place, as a little too much pressure will move the line a little too far, and an opposite pressure may put it too far in the original direction again. For nicety in adjusting the joint to the required point, some proportional dividers are fitted with a bar and micrometer screw, by which the joint can be drawn exactly to the required division. (See No. 162, p. 23.) Another plan is to have a rack fitted on the inside of the rectangular opening, and a pinion attached to the sliding joint, fitting into it; by turning the milled thumb-screw of the pinion the joint is moved up and down in the rectangular opening, with great regularity and exactness. Great care must be taken that none of the points of the proportional dividers get broken, for if one is broken all four must be altered, so that the graduations shall still represent the right proportions.

BEAM COMPASSES.

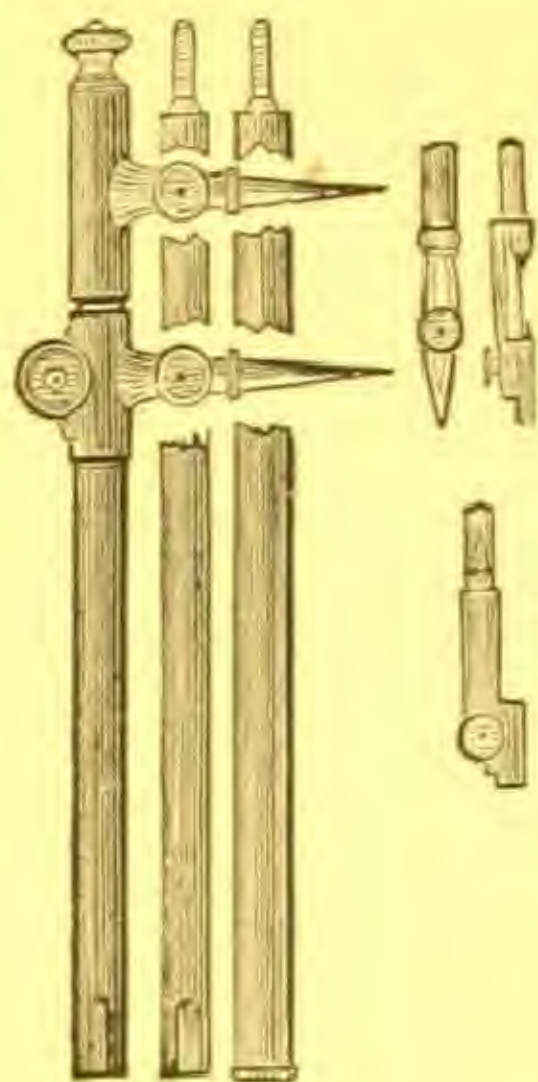
In drawing a circle of very long radius, for which the dividers with lengthening bar are insufficient, the draughtsman is obliged to make use of the beam compass, of which there are two forms. No. 80 represents one form, without the beam, which is made of wood. The main parts consist of two rectangular clamps, of German silver or brass, to the under side of which the points are attached. One of the points is made so that it can be detached, and in its place a point either for ink or lead pencil substituted. To use this form of beam compasses, fasten the metal clamps to the





edge of a wooden ruler, at the distance apart of the radius of the circle to be described; with one point upon the required centre, the other point is swung around, and the arc or circle completed. Under the whole length of one of the clamps a screw with fine thread and milled head is attached; upon this screw the point is adjusted; by turning the milled head, the point can be made to traverse from one side of the clamp to the other. The object of this screw is, after having adjusted the clamp on the ruler as near as possible, to enable the draughts-

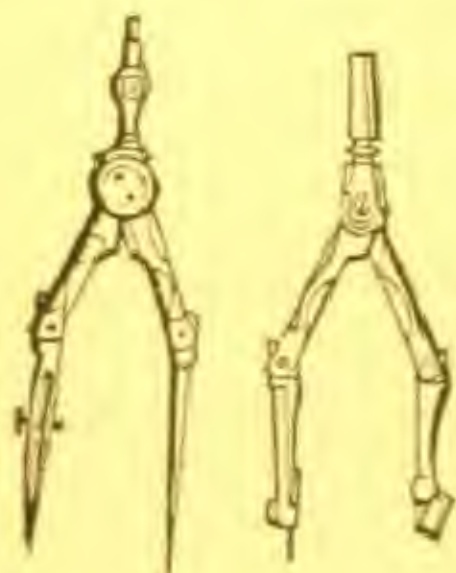
man to bring the points very accurately to the required distance apart by turning it one way or the other.



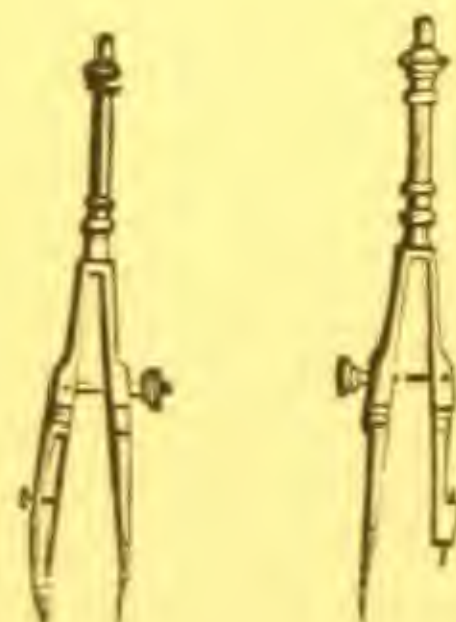
No. 170 represents the other form of the beam compass, in which the bar or rod is of German silver, about one-fourth of an inch in diameter, and divided into two or more sections, with screw joints, for the purpose of convenience in packing away when not in use. The points are attached to German silver tubes, which slide along the rod. One of the tubes can be adjusted to any position on the rod; but the other is fixed at one end, and can only be moved by the adjusting screw to regulate small distances. To prevent the tubes carrying the points from turning on the bar, a groove is cut the whole length of the bar, in which run steel guides projecting from the inside of the tube. When the bars are screwed together, care must be taken to have the groove in each section brought to its right position to make the cut continuous. With these beam compasses there are two round steel points, a needle, pen and pencil points; the needle point fits in place of the round steel point, which is attached to the stationary tube, and the pen and pencil points fit in place of the steel point attached to the movable tube.

THE BOW PEN AND BOW PENCIL.

These instruments are indispensable to an architectural or mechanical draughtsman, for describing small circles from one-sixteenth of an inch to two inches in diameter, such as the heads of screws, the hubs and tires of wheels, &c., &c.



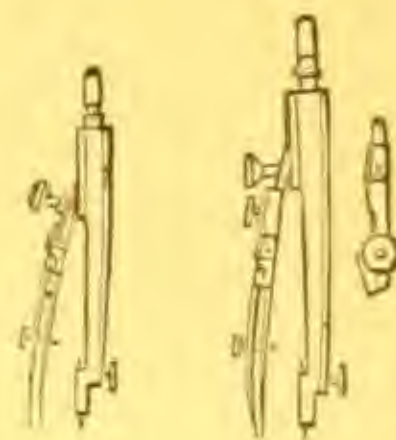
There are two kinds of bow pens and bow pencils. Those represented by adjacent cuts are about three inches long, and the legs are extended and closed by the pressure of the fingers; the joint upon which the legs move is the same as in the ordinary plain dividers; one of the legs is made with a permanent needle point, the other leg is a pen or pencil point; both legs are jointed in the middle, so that the points can always be set at right angles to the paper.



The other and best form of bow pen and bow pencil is that with spring and adjusting screw. Of these there are two kinds. Those represented at Nos. 81 and 84 are made wholly of steel, except the handle, which is either of Ivory or German silver. The legs are made of one straight piece of steel, which is bent in the middle until the two points come within one inch of each other, and then highly tempered. A steel wire, three-fourths of an inch long, having a fine thread cut on it, is fastened to the middle of one leg, and passes through the other; a small German silver nut is screwed on the end of this wire, and pressing against the leg, forces the points closer together; the parts of the legs above the screw being of tempered steel, when the nut is loosened, the points will move back with it.

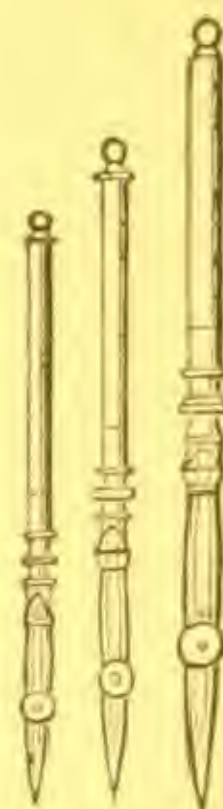
The other form of the spring bow pen and bow pencil is represented by Nos. 82 and 83. The leg, body and handle are made of one piece of German silver or brass, three inches long; the

lower end of the leg is finished with a small tube and clamp screw, for receiving and retaining a needle point; the body is almost twice the width of the leg, and a groove is cut the whole length of one of its sides; the pen or pencil point is attached to a tempered steel spring, the end of which is screwed fast into the upper end of the cut in the body; a steel wire, half an inch long, with a fine thread cut on it, is fastened into the body, and passes through the spring just above the pen or pencil point; a nut is screwed on the end of this wire, and bears against the spring and forces it in or lets it out of the cut in the body, which brings the pen or pencil and the needle point nearer together, or puts them farther apart. No. 82 represents the bow pen; the bow pencil is constructed in the same manner, but has a point for lead pencil instead of ink. No. 83 has both a pen point and a pencil point, and by simply changing one point for the other, can be used as a bow pen or bow pencil.



DRAWING PENS.

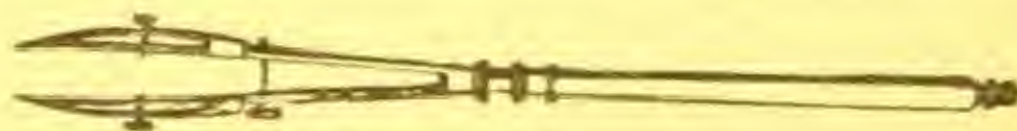
This is a most important instrument to every draughtsman, and should be well made and always kept in good order. It consists of two steel blades, attached to an ivory handle, and so bent that when the points are almost touching, there is space between the blades for holding ink. One of the blades is hinged where it joins the handle, so that it can be opened away from the other blade when it is to be cleaned. A steel screw, having a German silver head, is passed through the hinged blade and screws into the other blade; by turning this screw the points can be brought to the distance apart for making the required thickness of line. There are three sizes of these pens, viz.: $4\frac{1}{2}$ inches, $5\frac{1}{2}$ inches, and $6\frac{1}{2}$ inches long from the point of the pen to end of handle. To use the drawing pen, put the ink between the blades with a common writing pen, drawing it down and out between the points of the blades; screw the blades to the proper distance apart for making a line the required thickness. In drawing the line, the pen should be held firmly against the ruler, slightly inclined in the direction the line is being drawn; the points of both blades must touch the paper. The handles of most drawing pens are made to unscrew, and a needle is fitted in the screw end, which can be used for pricking drawings from one paper to another.



When lines of red ink are to be drawn, it is found best to use a drawing pen having the blades made entirely of German silver instead of steel, as the acid in the ink does not act upon and injure the German silver as quickly as it does the steel.

RAILROAD DRAWING PEN.

For drawing close parallel lines in mechanical and architectural drawings, or to represent canals and railroads, a double drawing pen is used. It consists of two drawing pens attached parallel to each other on one handle; the distance of the two pens apart is regulated by the adjusting screw between the end of the handle and the top of the pens.



DOTTING PEN.

The dotting pen is made like the drawing pen, but has a finely toothed wheel, which revolves between the points, and instead of a continuous ink line, it makes a dot for each tooth, and consequently, a line of dots, when drawn between two points. It is used when imaginary lines are to be shown on the drawing.



MAP PERAMBULATOR.

The map perambulator is used for measuring the length of curved lines, such as the courses of rivers and roads, &c., &c. It consists of a finely toothed wheel, about three-fourths of an inch in diameter, working back and forwards upon a fine steel screw; the screw is supported in a neat German silver frame, to which an ivory handle is attached. To use the instrument, screw the wheel against the side of the German silver frame,

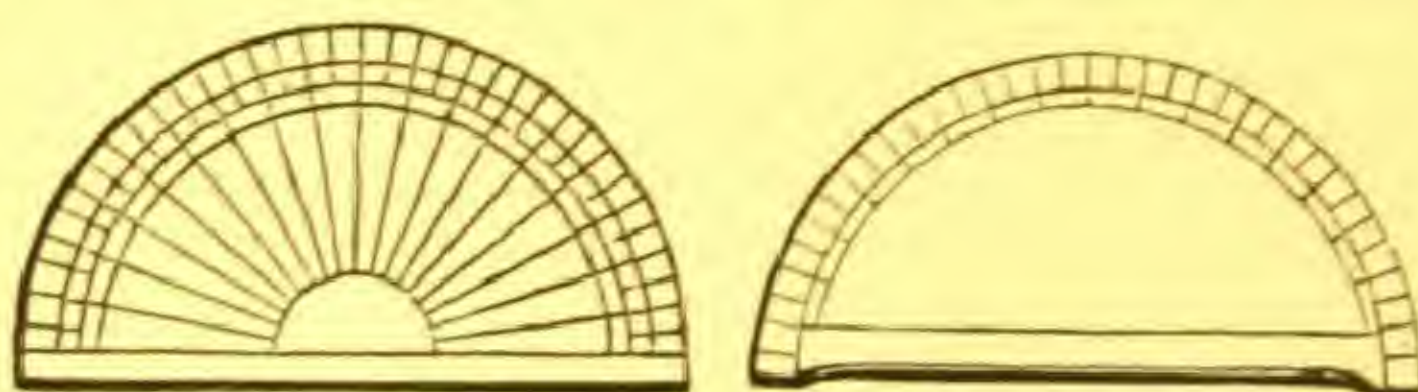
from which a point projects almost to the lower edge of the wheel, then roll the wheel along the crooked line until it reaches the end; then go to the scale on the edge of the map or drawing, and roll the wheel back to the side of the frame from which it was started, and the length of the crooked line will be ascertained.

Every draughtsman should provide himself with a fine oil stone for dressing the points of his dividers and pens, so as to keep them always in perfect working order; he should also have a fine piece of buckskin, for wiping the instruments off before returning them to the case. In handling and using the instruments, the steel parts should come in contact with the fingers as little as possible, as the perspiration rusts the steel, but does not materially injure the brass or German silver.

THE PROTRACTOR

Is used for plotting surveys and laying off angles in general. Nos. 301 and 306 represent semicircular pieces of horn, brass or german silver, on the middle of the

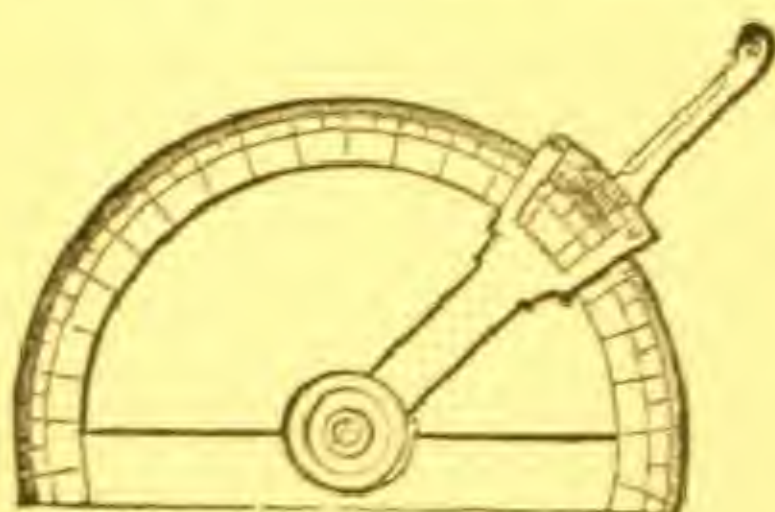
diameter of which a dot or small cut is made, indicating the centre; the edges are divided into 180 parts or degrees, or 360 parts or half degrees; the best protractors are always divided in half degrees. The horn protractors are made of a solid piece of horn, rolled as thin as



writing paper; they are transparent, and the lines for each ten degrees are drawn almost from the centre to the edge (see No. 301). To reduce the weight of metal protractors, and render them more convenient to use, a semicircular piece is cut out, leaving all round an edge one-half to three-quarters of an inch across; the circular edge is then divided in degrees or half degrees (see No. 306).

To protract a survey, draw a north and south line, and take a point about the middle; bring the centre of the protractor over this point, and make the straight edge come even with the line; now set off the bearings on one side of the line for eastings, and on the other for westings; then remove the protractor, and draw faint lines from the centre to the points marked off, and with the parallel ruler, dividers and scale, bring the lines to connect, and form a figure of the survey. To set off an angle from a given point on a given line, bring the centre of the protractor to the point, and make the edge come on the line; then with the point of the dividers mark on the paper where the required degree comes, and draw a line from the given point to that point, and the angle made by the two lines will contain the required number of degrees.

There is always more or less difficulty in marking off the degrees from the protractor, with the point of the dividers, to do it accurately and distinctly, so that when the protractor is removed, the direction of the required line can be readily seen. To obviate

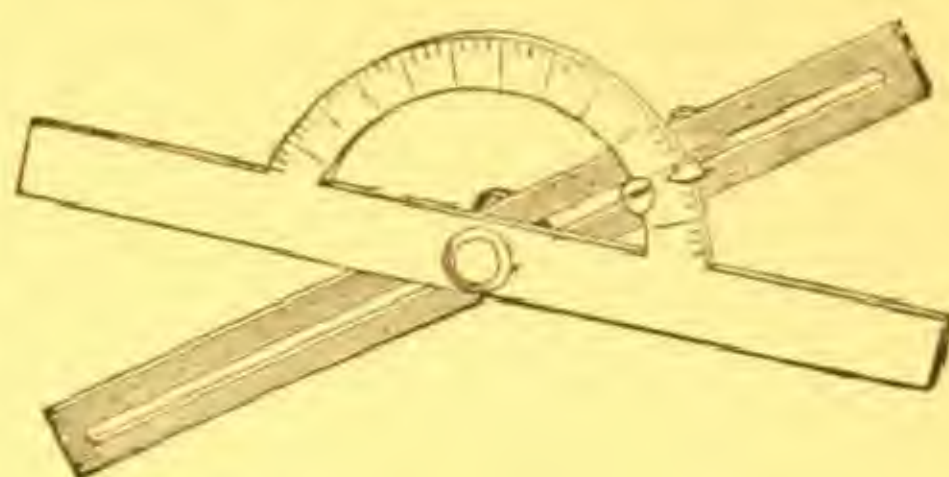


this difficulty, the protractor with arm is made; the arm is simply a ruler of the same material as the protractor, jointed to the centre, so that it can be revolved from one side to the other; it projects about three inches beyond the edge of the protractor. After sitting the protractor on the line with its centre over the point from which the line is to start, bring the beveled edge of the arm to the required degree, and with the point of the pencil resting against that edge, draw a straight line; now, when the protractor is removed, there is no doubt about the position and direction of the line.

The protractor with arm is divided in half degrees, and with it angles can be laid off correctly to fifteen minutes, but when great accuracy is to be observed, and the angles are required to be laid off to the very minute, a vernier must be attached to the arm. It is made by widening the arm, and cutting a square opening in it at the part where it crosses the edge of the protractor; the edge of the opening which meets the graduated edge of the protractor, is divided in such a manner as to enable the parts of a degree less than thirty minutes to be accounted for correctly, when laying off the angle. For a general description of verniers, see Gillespie's Land Survey, Chapter II., page 228.

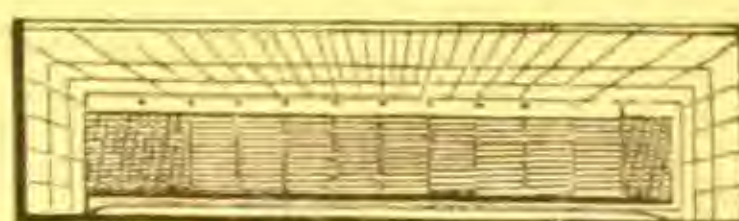
A whole circle protractor is made and used the same as the half circle; it is, in reality, two half circle protractors, having the same diameter.

The bevel protractor is made of steel; it is half circle and with arm; its straight edge projects beyond the arc both ways. The arm, instead of being fastened permanently at the centre, as is the case in other protractors with arms, has a narrow opening cut in it, almost from one end to the other; the arrangements which hold the arm to the protractor fit in this cut, and a clamp nut retains it in its place by loosening the clamp nut the arm can be slipped so as to project above the arc, or below the straight edge, as may be wanted. This protractor is intended for the use of machinists, in obtaining or laying off bevels upon a piece of machinery.



RECTANGULAR PROTRACTOR.

This form of protractor is generally made of ivory, and six inches long, by one and three-quarters to two and a half inches wide; three edges of one side are divided in parts corresponding to the degrees and half degrees of the semi-circular protractor, the other edge has a division half way between the ends which represents the centre of the circle and the point in which the lines around the three edges would all meet, if continued. To understand the graduations around the edges, take a half circle protractor and bring its centre to the mark on the side not graduated, and make its straight edge correspond with that side; now, it will be found that where the graduations on the edges of the two protractors come in contact they represent exactly the same number of degrees; and if the other lines on the rectangular protractor were continued they would meet the corresponding ones on the semi-circular protractor. This protractor is used for the same purposes and in the same manner as the semi-circular protractor.



Besides the protracting scale around the edges, one side of the rectangular protractor has on it a diagonal scale of equal parts, and scales of 20, 25, 30, 35, 40, 45, 50 and 60 equal parts to the inch; also, a scale of chords for arcs of a circle four inches diameter; on the other side are scales of $\frac{1}{2}$ in., $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$ in., each subdivided into twelve parts; also, a scale of chords for arcs of a circle six inches diameter; the edge which has the centre mark on it is divided into forty parts to the inch.

The diagonal scale consists of a series of eleven parallel and equi-distant straight lines; across these, and at right angles to them, another series of lines are drawn, having the spaces between every two lines to measure exactly one-quarter of an inch. The top and bottom line of the eleven parallel lines have the first quarter of an inch divided into ten equal parts, also, the last half of an inch. A line is drawn from the first of these small sub-divisions of the first parallel line diagonally across the other nine lines, to the beginning of the sub-divided part of the lower line; and from each of the other sub-divisions of the upper line, lines are drawn parallel to the first diagonal line. It is readily seen, that at the point where one of these diagonal lines crosses each one of the nine parallel lines, it increases its distance from the perpendicular line by one-tenth of one of the small sub-divisions for every parallel line.

To take off distances of two figures, say 46,—chains, feet or miles,—place one point of the dividers at the fourth perpendicular line on the top parallel line, and open the dividers to the sixth sub-division at the beginning of the line. If we have three places of figures to take off, say 467,—chains, feet or miles,—open the dividers as before, along the top line, from the fourth perpendicular line to the sixth sub-division; now bring the point of the dividers down the fourth perpendicular line to the seventh parallel line, the other point of the dividers then will not be on the intersection of the sixth diagonal line and the seventh parallel line; but when it is opened to that point the dividers will take in the required distance, viz., 467.

GENERAL RULE.—To take off any number to three places of figures from a diagonal scale: on the parallel line, indicated by the third figure, measure from the diagonal line, indicated by the second figure, to the perpendicular line, indicated by the first figure.

ENGINEER'S CHAIN SCALES, OF EQUAL PARTS,

Are those which have one inch, or a portion of an inch, divided into a number of equal parts; they are marked 20, 25, 30, 35, 40, &c., &c.; and it is to be understood that each one of the fine divisions at the beginning of the lines is that part of an inch represented by the figures before the line; that is, if 20, each one is the $\frac{1}{20}$ of an inch, and if 40, each division is the $\frac{1}{40}$ of an inch. There are but ten of the finer divisions marked off at the beginning of each line, after that, each graduation represents ten of the very small ones. On the ivory protractors, and the scales usually with sets of instruments, it will be found that there is another set of divisions over the fine ones, on each line; these divide the first large space into twelve equal parts.

The measuring chains used by engineers are fifty or one hundred feet long, and each link one foot long; therefore, if each one of the large divisions on the scales is called a chain, the fine divisions will each represent ten links, if the chain used be one hundred feet long, and five links, if a fifty foot chain is used. The size of the drawing is therefore regulated by the selection of one of these scales to lay off the length of the lines by. If the measures are in feet and tenths of a foot, each of the large divisions can be called one foot, and each of the fine divisions will be one-tenth of a foot. If the measure is in feet and inches, each one of the large divisions can be called one foot, and each one of the twelve fine divisions above the other fine divisions, will be one inch.

ARCHITECT'S SCALES, OF EQUAL PARTS.

In making a plan of a building or a drawing of a piece of machinery, it is necessary to make a small fraction of a foot represent a line, which, in reality, measures a whole foot; the scales mostly used for this purpose are $\frac{1}{16}$ of an inch, $\frac{3}{32}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 3 inches to the foot; that is, every 16th of an inch is laid off the whole length of the scale, to represent feet, and the first 16th is divided into twelve equal parts, to represent the inches; and the same with the $\frac{3}{32}$, and all the other divisions to 3 inches to the foot.

SCALE OF CHORDS.

The chord of an arc is a straight line joining the two extremities of the arc. The graduations on the scale of chords represents the length of the chords of all arcs, from one degree to ninety degrees. The chord of an arc of sixty degrees is always equal to the radius or half the diameter of the circle. The chord of sixty is always used for describing arcs for laying off angles, or measuring angles already laid off.

On some of the ivory scales there are found a number of other graduations, marked Rhu., Lon., Sin., Tan., S. T., Lat. These initials stand for Rhumbs, Longitudes, Sines, Tangents, Semi-Tangents, and Latitudes. As these are only used in the study and application of navigation we will omit describing them here, and refer those who wish to know their application to Heather's Treatise on Mathematical Instruments, page 16.

The scales described in the preceding pages are those usually found on the six inch ivory protractors, and six inch ivory scales. As a general rule, draughtsmen would prefer scales of greater length than six inches, and with only a certain class of divisions on them. The Ivory Chain Scale is twelve inches long, and has two edges bevelled, and graduated either to 10 and 10 parts to the inch, or 10 and 20, and so on up to 100 parts to the inch; the fine graduations being continued the whole length of scale.

The Triangular Chain Scale is made of well-seasoned boxwood; the six edges are graduated each with a single scale, viz: one edge has 10 parts to the inch, one 20 parts, one 30 parts, one 40 parts, one 50 parts, and one 60 parts.



The Triangular Scale for architects has five edges, graduated with two scales on each edge, as follows: one

edge has each $\frac{3}{32}$ of an inch, and each $\frac{1}{16}$ of an inch marked off; the $\frac{3}{32}$ are numbered from one end and the $\frac{1}{16}$ from the other. One edge has each $\frac{1}{8}$ of an inch, and each $\frac{1}{4}$ of an inch; one edge has each $\frac{3}{8}$ of an inch, and each $\frac{1}{2}$ of an inch; one edge has each $\frac{1}{2}$ of an inch, and each an inch; one edge has every $1\frac{1}{2}$ inches, and every 3 inches; and one edge is divided into inches and 16ths of an inch. The first division of the $\frac{3}{32}$ scale is divided into four equal parts; consequently, if the $\frac{3}{32}$ represent one foot, each of the sub-divisions will represent 3 inches. The $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{3}{8}$, have the first division

divided into twelve equal parts; therefore, if the primary division represent one foot, each of the sub-divisions will represent one inch. The $\frac{1}{2}$ and $\frac{3}{4}$ of an inch have the first division divided into twenty-four equal parts; therefore, if the primary divisions represent one foot, each of the sub-divisions will represent the half of an inch. The 1 inch and $1\frac{1}{2}$ inches have the first division divided into forty-eight equal parts; and if the primary division represent one foot, each of the sub-divisions will stand for one-quarter of an inch. The 3 inches has the first division divided into ninety-six equal parts; and if the primary division represent one foot, each of the sub-divisions will represent the one-eighth of an inch.

The Ivory and Boxwood Flat Architect's Scales, Nos. 406 and 454, are 12 inches long by $1\frac{1}{2}$ inches wide, and have the following divisions on them, viz.: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, and 3 inches to the foot; the $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch divisions are graduated on the two edges of one side; all the other divisions are laid off on the body of the scale. The primary division of each scale is divided into twelve equal parts, to represent inches; and in the $\frac{3}{8}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, and 3 inch scales, the primary divisions of each is also divided into ten equal parts, by faint dots over the twelve parts; each one of these represent the one-tenth of a foot, when the primary division is taken for one foot.

The Ivory and Boxwood Architect's Scales, with 16 different graduations, all brought to the edge. Nos. 410 and 458 have the same graduations on them as Nos. 406 and 454; but have them arranged in such a manner that the divisions of each graduation come out to one or the other of the four edges. The advantage of having the graduations on scales come out to the edges is, that the edge of the scale can be brought to the line, and the required distance marked off without taking it with the dividers, thereby insuring greater accuracy and less trouble.

PAPER SCALES.

A very convenient though not very lasting scales; are printed from copper-plates on strips of card-board; they are nineteen inches long by one and a half inches wide; each strip has but one scale on it, and that on one edge. They are usually put up in sets of six, thus: $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 3 inches to the foot, for series A; and $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, and $\frac{7}{8}$ of an inch to the foot, for series B; and 10, 20, 30, 40, 50, and 60 parts to the inch, for series C. These scales being made of the same material as the paper upon which the drawing is made, the expansion and contraction, from moisture and heat, are equal upon both; another advantage is, they are not as liable to soil the paper as scales made of other material.

STEEL RULES, OR SCALES.

These scales are intended for the use of machinists, in making nice measurements on delicate work. They are made of steel, and divided into inches on all four of the edges; the first inch on one edge is divided into 16 equal parts, the next inch into 32 equal parts, and the next into 64 equal parts. Another edge has the first inch divided into 20 equal parts, the next inch into 50 equal parts, and the next inch into 100 equal parts. Another edge has the first inch divided into 12 equal parts, the next inch into 24 equal parts, and the next inch into 48 equal parts; and the fourth edge has the first inch divided into 8 equal parts, the next inch into 14 equal parts, and the next inch into 28 equal parts.

THE SECTOR.

These are usually made of two pieces of ivory, each six inches long, and jointed together like the carpenter's rule; it is an instrument but little used at the present time, and therefore we will not attempt to enter into a description of it here, but refer for complete information about its construction and use, to Heather's Treatise on Mathematical Instruments, page 34.

STRAIGHT EDGES.

Are rulers, the edges of which are very carefully finished, to enable the draughtsman to draw a perfectly straight line. They are made of some kind of hard wood or metal. The metal ones can be made more accurately than the wooden ones, because their edges can be ground on iron plates, with emery, and finally finished by grinding the edges of two rules together, also with emery.

In order to ascertain whether a straight edge is perfectly true, take two of them and place one edge of one against an edge of the other, and hold them up between

the eye and the light, and observe if any light can be seen between the edges; all the edges should be tried in the same manner.

TRIANGLES

Are used for laying off angles, and with a straight edge for drawing parallel lines. They are made of hard wood, rubber, or metal, and are either solid or with open centre; the angles are usually 30, 60, and 90 degrees, or 45, 45, and 90 degrees; the length of the sides vary from 5 to 12 inches. The wooden triangles are lighter, less expensive, and less liable to soil the paper than the metal, but cannot be made so accurately; the wood triangles are also apt to warp and become incorrect by wear in using. The advantage of the open over the solid triangles is, when of wood that they are less liable to warp, and if of metal they are lighter; besides these reasons, they do not conceal so much of the drawing, and in using them the draughtsman can see better how to draw his lines. To see if the right angle of a triangle is correct, draw a straight line, and bring the edge of one of the sides exactly on it, having the right angle about the middle of it; then draw a line along the other side, from the right angle; now, it is to be supposed there is a right angle on each side of the last line drawn; to prove it, take up the triangle and place it in the same position it occupied before, but on the opposite side of the last line; now, if the angle of the triangle is not 90 degrees, when one side corresponds with its line the other will not. To prove the angle of 30, see if it is one-third of ninety, and the angle of 60 should be double of the 30 angle.

The edges of the triangle can be tested in the same manner as the edges of a straight edge. The simplest way to test the right angle of a triangle, is by the right angle of the T square, one edge of the triangle being held against the blade and the two right angles brought together; the other side of the triangle should fit evenly on the head of the T square; the other plan is the most correct, as there may be an error in the angle of the T square. The triangle is one of the most useful articles in a draughtsman's set of instruments.

IRREGULAR CURVES

Are made of wood, horn, or rubber; a variety of curves are cut upon the outer edges, and pieces are cut from the body in such a manner that there is a curve for every side of the opening. These curves are much used in design drawing, also for architectural drawing; some little use is made of them in civil engineering. The various patterns are fully illustrated in our Catalogue.

T SQUARES

Are usually made of hard wood or rubber, and are of three different kinds. The first kind has the cross-piece or head fastened permanently and securely at right angles to the straight edge or blade. The second kind has the head attached to the blade by a clamp-screw, which allows the head to be fixed at any angle to the blade, and firmly clamped where fixed. The third kind has the head permanently and securely fastened at right angles to the blade, and a secondary head of the same size attached to it with a clamp-screw, and thus, when other angles than right angles are to be made, the movable head can be fixed at the proper inclination to the blade, while a right angle is still maintained by the fixed head. In the first two kinds the blade is fixed to one of the flat sides of the head, and when used, the edge of the head comes against the side of the drawing board, while the blade lies evenly on it; in the third kind the blade is attached between the two parts of the head, so that in using either the fixed or movable side there is an edge to come against the drawing board, while the blade rests on the board.

The T square is always used in connection with a drawing board, and with it and a triangle all the straight and parallel lines of a drawing are very easily added; the head of the T square being held against the edge of the board, and the triangle resting against the edge of the blade, along which it can be slid for making parallel lines; by sliding the head along the edge of the drawing board other parallel lines can be drawn. The edges of the blade of the T square are apt to get rough from constant use; to prevent this, and also to make the blade stiffer and less liable to warp, a thin strip of brass is set into the edges, and finished off smooth and true.

The angles of the T square should be tested in the same manner as the angles of a triangle, and the edges of the blade as the edges of a straight edge.

PARALLEL RULERS

Are of two kinds; the first and most common consists of two straight edges, of ebony or metal, from six to twenty-four inches long, by three-quarters of an inch to one and

a half inches wide, joined together by two parallel strips of brass, which move upon pivots at the points where they are attached to the rulers; thus, when the bars are put apart they are always held parallel to each other by the brass strips, consequently, if the edge of one of the bars is brought to a line, and firmly held there, and the other bar pushed away from it, a line or lines drawn by the second bar will be parallel to the original line.

ROLLING PARALLEL RULERS.

The other form is a solid straight edge, from nine to eighteen inches long, by two inches wide, made of a thick piece of ebony wood, or metal; this is mounted upon two small rollers, of equal diameters, one near each end, and both revolving upon one axis. If one edge is brought to a line, and the ruler is pushed from it, the two rollers being of equal size, and on the same axis, will move both ends along the paper with equal rapidity; and any lines drawn in the new position will be parallel with the first line.

Some of this form of parallel rulers have the edges graduated, which is very convenient in many kinds of drawings; the circumference of the wheels are often graduated for the purpose of drawing a number of parallel lines at the same distance apart.

FASTENING TACKS

Are small nails used for fastening the paper to the drawing board; they have large flat heads and very small sharp points; the heads are round, and made of brass, German silver, or steel, and the points of the best tempered steel, carefully sharpened. In putting them into the drawing board, the point should be well started with the fingers, and the pin pushed home with a small bottle cork. If the thumb is used for pressing them in there is danger of the upper part of the pin coming through the head, and injuring the thumb.

A new form of fastening tack has just been introduced; it is a right-angled piece of metal, each side of which is one-half an inch long, with three points; it is intended for fastening the paper at the corners.

HORN CENTRES

Are circular pieces of very thin semi-transparent horn, about one-half an inch in diameter, with very short and delicate steel points projecting from one side. They are used to put over the point which is to be the centre of several circles or arcs; the centre point can be seen through the horn, and the point of the dividers can be put directly on the centre point; but the paper is shielded from being punctured and disfigured by frequent use of the same hole as a centre.

THE DRAWING BOARD.

A good drawing board is indispensable to the draughtsman. The qualities it is necessary that it should possess are an equal surface, and perfectly straight edges at right angles to each other. For these reasons the best drawing board is that which will leave the wood free, so as to allow these changes to take place without affecting the surface or square of the board. This is nearly effected by those described under No. 680 of our Catalogue. In addition to the above described form, we have the Clamped Drawing Board, shown and priced in No. 676 of our list, and the Dovetailed Board, as described in No. 677. The Panelled Drawing Board, shown in illustration No. 679, is a rectangular frame of walnut, with an open centre, into which a soft pine board, carefully planed and perfectly smooth, is fitted, and fastened in with buttons. The frame is made of hard wood, so as not to wear easily and become incorrect, and the centre of soft wood, so that the fastening pins can be easily put in. The angles and edges of the frame should be as correct as possible; though a little inaccuracy in these respects is not very important, as only one side is used for resting the head of the T square against, and the lines which would require another side to be used are added with the triangles and the dividers. All of our boards are made of the very best, well seasoned, straight-grained pine wood, especially selected and steam-dried for the purpose.

AMSLER'S POLAR PLANIMETER.

By means of AMSLER'S POLAR PLANIMETER, a person entirely ignorant of Geometry may ascertain the area of any planimetrical figure, no matter how irregular its outlines may be, more correctly and in much shorter time than the most experienced mathematician could calculate it.

The management of the Instrument can be easily learned in half an hour, and in size it is no larger than a two feet folding rule.

The Planimeter indicates square feet or square inches, and acres for surveying.

DIRECTIONS.—Preparatory to the use of the Instrument, ascertain its state:—The Index roller D must play easily without coming in contact with the nonius (or vernier). The screw centres, on which its axis revolves, must be adjusted so as to allow perfect freedom of rotation; the same is to be observed for the centre pin C.

The needle point E ought to project but very little from its socket. Great care must be taken not to bend any part of the instrument.

To ascertain the area of a figure in square inches, slide the square rod A into the tube H, so that the line marked 10 sq. in. (10 square inches) stands fair with the bevelled part of the tube J. Then set the instrument on the paper, so that the index roller D, the tracing point F, and the needle point E rest on the paper; press the latter point a little on the paper, not enough to pierce it through. This point is to remain stationary during the whole operation. Set the tracing point F on any point P of the outline, and mark that point, and read off the state of the counting wheel G, and the index roller D. Suppose the counting wheel indicates 3 (as in cut,) the index roller 905 (90 degrees to be read on the index roller, and 5-10 on the nonius) so that the O of the nonius stands on 90 5-1000 of the circumference of the index roller. Write down the number just read off thus, 3,905.

Now follow with the tracing point F, the outline of the figure, or part of the figure, to be measured, with great exactness, in the same direction as the hands of a watch would move, until you arrive at the starting point.

Straight lines may be followed along a rule; then read off again the state of the indicators. Suppose you find now 5,763, *i. e.* the counting wheel indicating 5, and the index roller and nonius 76 3-10 degrees. From these two readings the area found is to be obtained, and here two points are to be considered.

A. If the needle point E is outside of the figure just traced round, the first number (3,905) is to be deducted from the second number (5,763).

5,763

3,905 and the remainder (1,858) is to

be multiplied by ten equal

18,58:

which is the area desired, 1,858

B. If the needle point E is inside of the outlines of the figure, add to the number last read off (5,763) the number marked on the side of the square rod next to where 10 sq. in. is marked on the upper side.

In this case it is 20,240, the last number 5,763 read off

The number on side 20,240

26,003 Deduct from this

amount the number first read off 3,905

22,098

Multiply this remainder by ten, equal 220,98, and this is the amount of square inches, or area of the measured figure.

It is of no consequence whether the roller moves inside or outside of the outlines of the figure, provided it moves on a smooth surface even with the figure.

To obtain the area in square feet, slide the square rod into the tube up to the line marked 0,1 sq. ft. or 0,5 sq. ft. In this case the difference between the first and second readings of the indicators is to be multiplied by 0,1 or 0,05. If the difference, for instance, is 4,653, the rod being up to the line marked 0,1 sq. ft., then is $4,653 \times 0,1 = 0,4653$ equal to the area in decimal fractions of a square foot.

If the needle point is within the outlines of the figures as described in B, proceed the same way as at B, but multiply by 0,1 or 0,05.

If the figure to be measured is at a reduced scale, the result has to be multiplied by the square of the proportion of the reduction. If the proportion of the figure to the full size is as 1 : 10, the result is to be multiplied by $10^2 = 100$ —for instance: the result of the first example is 1,858, which multiplied by 100, $(1,858 \times 100) = 1858$ sq. inches, would be the amount of the area.

If the amount of acres is to be ascertained, the proportion of the reduction being 1 : 1000, slide the square rod up to the line marked 2 ac. 1 : 1000, or 1 ac., and operate

as indicated above; the result is to be multiplied by 1 or 2 instead of 10 or 5. If the rod is set up to the line marked 1 ac., no multiplication is necessary.

Should the plan of the piece of land be drawn on a smaller scale than 1-1000, for example 1-5000th, then multiply the result with the square of the proportion of the reduction to the scale of 1-1000. Thus far the scale of 1-5000 the result would have to be multiplied by $5 \times 5 = 25$ (1-5000 being to 1-1000th as 5-1.) If the scale is 1-500th multiply the result by $\frac{1}{4} = \frac{1}{4}$, that is to say, divide the result by 4.

Remark.—If on reading off the horizontal or counting wheel G, the indicator points near the middle line between two figures, say between 3 or 4, then see how the index roller stands to the nonius. If the 0 on the nonius is on the lower side of the 0 of the roller, therefore near 100, then read 3, but if the 0 on the nonius is on the upper side, therefore near 0 on the roller, then read 4 for unity.

If the horizontal wheel turns on its axis during the tracing operation, so that it goes beyond 0 (in fact 10), and even marks several revolutions and then stops at any number, for instance 7, you read 17 or 27, &c., adding as many times ten as the wheel has made full revolutions.

It is easy to notice the number of revolutions. If the wheel G marks 6, and the roller D is for instance on 0 degrees 7-10 degrees, or on 4 degrees 7-10 degrees, then the reading is of course 6,007, or 6,047. The number read off the nonius always taking the third place after the units.

The cut shows the instrument two-thirds the natural size.

Draftsmen, Engineers, Surveyors, Ship Builders, Architects, Machinists, will please devote a few moments only to the examination of this instrument, and they will at once be convinced of its great importance and value.

CROSS SECTION TRIANGLES AND BATTER ANGLES,

Are a series of angles constantly recurring in railroad engineering. The Cross Section Triangle has its base and perpendicular proportional to each other, and is used for drawing cross sections of cuttings and embankments.

Batter Angles are used for drawing the batter or slope in rock, cuttings, walls, and piers.

RAILROAD CURVES,

Are thin pieces of wood or card-board cut into arcs of circles of radii from 2 to 250 inches; they are generally made from 3 to 18 inches long by 2 inches wide, the length increasing with the radius.

For description of the different kinds of Drawing Paper, Colors, Brushes, Pencils, &c., their use and how to use them, we would refer to Warren's Manual of Drafting Instruments and Materials, on page 114 of this Catalogue.

POCKET COMPASSES,

Are small compasses, of sizes not too large to be carried with convenience in the pocket, and are very useful in travelling, in order that the relative positions of places may be known at all times. They are made of a great variety of plans and forms; as without stop and with stop to needle; with covers to face and without; with agate centres to needle and without, and with graduated dials and without. The stop to the needle is an arrangement by which the needle can be lifted off the centre pin and held tightly against the glass face, when the compass is not in use, and thereby prevent the rapid dulling of the point and wearing of the centre, which takes place when the needle is constantly in motion. The object of the cover is to prevent the glass which covers the face from getting broken, and the compass injured in other ways. The agate centre is a watch jewel, fixed in the centre of the needle, where it sets on the centre pin; the jewel being very smooth and hard causes the needle to vibrate and settle more correctly, and does not become worn by the point, though in constant use. The object of the graduated dial is to give the exact bearing of a place from a given point.

THE UNIVERSAL SUN-DIAL,

Is a pocket compass, over the face of which a metal rim is hinged, having its upper surface divided into the proper divisions to represent hours and minutes; a straight pin is fixed in the centre of the rim or dial, upon a bar, the ends of which revolve in the edge of the rim; when in use the pin is upright, and when not in use is turned down level with the rim. A graduated arc of 90 degrees is attached to the compass face, and passes through the outside edge of the dial rim; this arc is jointed at its

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base, so that it can be laid flat when the instrument is not in use. To use of sun-dial, place it in the sun, as nearly level as possible; raise the graduation then raise the dial rim, and bring the arrow on its outer edge to the degree which represents the latitude of the place; now lift the pin perpendicular to of the dial rim, and turn the compass box around until the blued end of the directly over the North line; the shadow of the upright pin will then be across the dial rim, and the graduation which it falls upon will be the time

PRISMATIC AZIMUTH COMPASS.

With this instrument horizontal angles can be observed with great rapidity with considerable degree of accuracy. It is, consequently, a very valuable instrument to the military engineer, who can make his observations with it while holding in his hand, with all the accuracy necessary for a military sketch. It is also a valuable instrument for filling in the detail of an extensive survey; after the principal lines have been laid down by means of observations made with the transit instrument for any purpose, in short, in which the portability of the instrument and the execution are of more importance than extreme accuracy.

For a complete description of the instrument, and how to use it, see Heather's Treatise on Mathematical Instruments.

GEOLOGICAL COMPASS.

This is an ordinary pocket compass, to which is added attachments for taking angles of inclination in the strata of rocks. It is from two to two and a half inches in diameter, and has a ring like a watch; the dial is a metal rim, raised about one inch from the bottom of the compass, and divided into 360 equal parts. The needle has an agate centre and stop attachment. The bottom, or rather the compass, is divided into 90 equal parts or degrees, from the North to the West line, and also into the same number from the West to the South line, the point being at the West line. A delicate pendulum, with pointer, swings from a centre pin and traverses the arcs on the face. Through the ring of the compass a metal slide is fixed, which pushes in under the bottom plate of the face. When the instrument is to be used for taking inclinations, pull out the metal slide and place the compass box upright, and resting it on its edge and the slide; if the surface of the box is placed perfectly level, the pendulum on the face will hang directly over the O point, but if the strata dips North or South, the index on the pendulum will point at the graduation which indicates the angle of inclination.

THE MINERS' COMPASS.

Consists essentially of a dipping needle, about 2½ inches long, which is attracted towards any mass of iron and thus discovers its position.

When used for tracing ore, the observer should hold the ring in his hand, and move the needle north and south, standing with his face to the west.

If held horizontal, it serves, of course, as a Pocket Compass, having a cover not shown in the cut.

THE POCKET COMPASS WITH SIGHTS.

This little instrument, shown with Jacob-staff socket in fig. 962, though small, is very convenient in extensive surveys like the larger compasses we have described, is found convenient in making explorations, or in retracing the lines of government surveys, or in locating land warrants, &c.

The sights are made with a slot and a hair, on opposite sides of the compass, the joints near the base, so as to fold over each other above the glass, when the instrument is packed in its case.

The circle is graduated to degrees, and figured from 0 to 90 each way from the North line.

The needle is suspended upon a jeweled centre, and is raised by the lift screw, as shown in the cut.

The Jacob-staff socket is often used with the compass, being screwed on the side, and detached at pleasure.

The mountings are all that are furnished, the staff itself being easily attached to a common walking stick.



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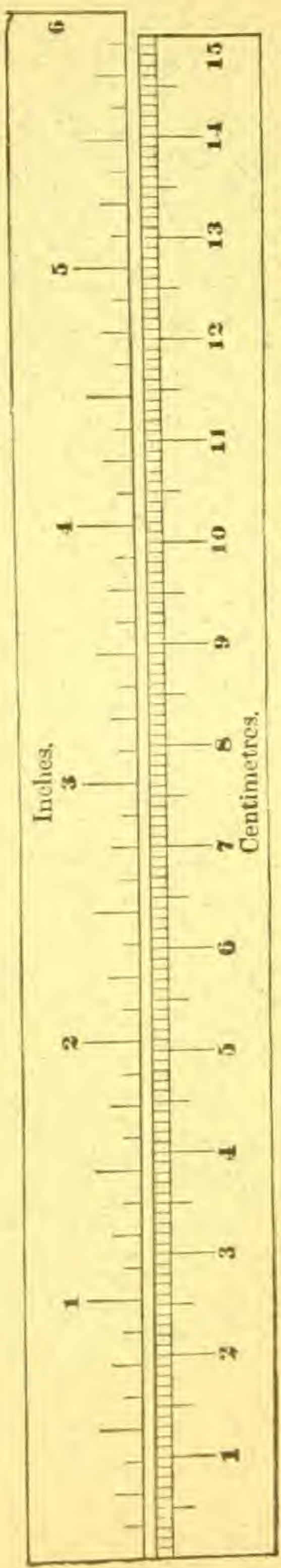
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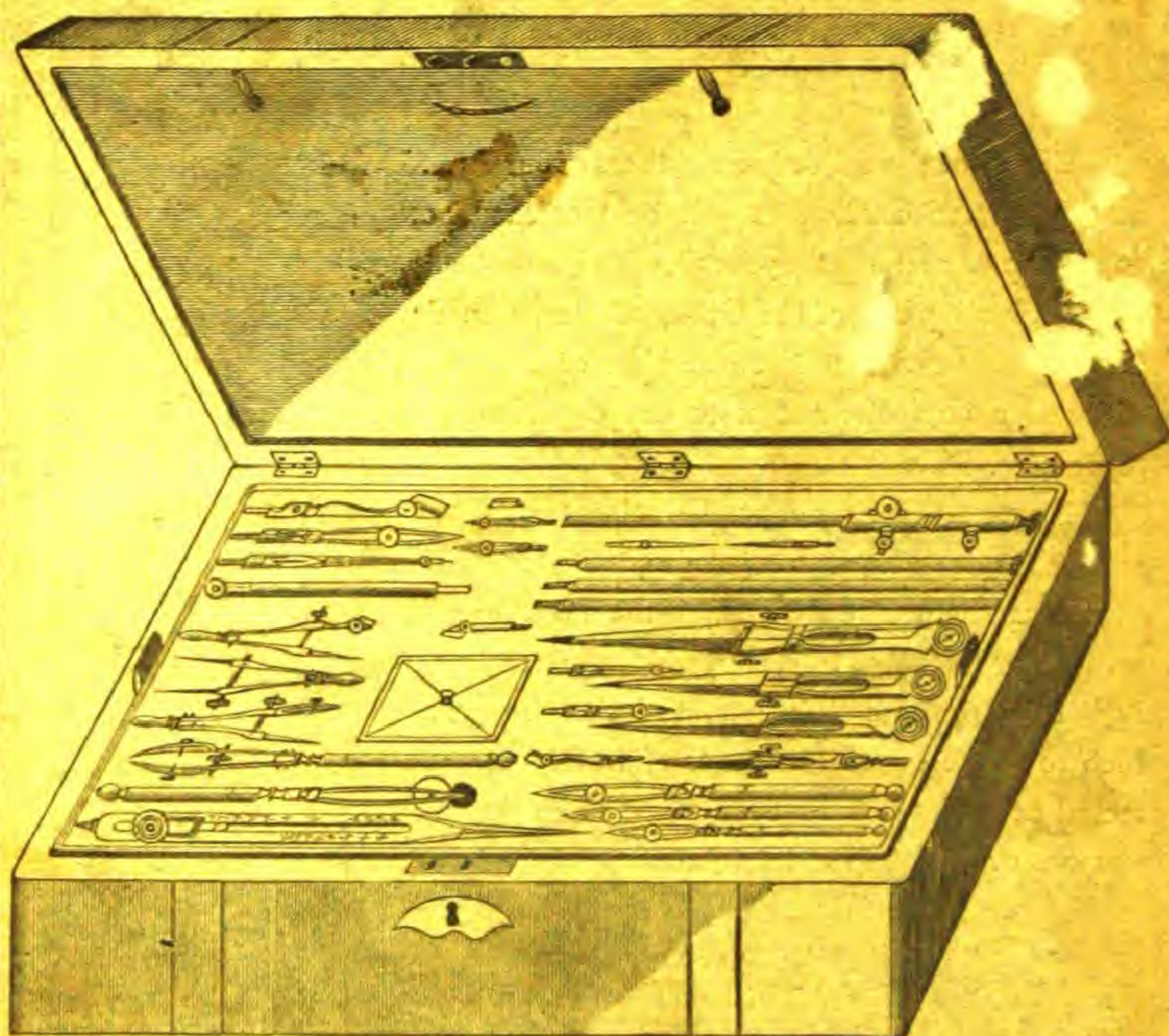
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For comparison of the Metric Measure recently adopted by Congress, with the inch measure now in use,
we insert the above Diagram.

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